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CONTRIBUTIONS BY ALL SECTIONS OF THE
AGRICULTURAL EXPERIMENT STATION

MICHIGAN AGRICULTURAL EXPERIMENT STATION QUARTERLY BULLETIN
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SOME GROWTH CHARACTERISTICS OF PERENNIAL HAY AND PASTURE CROPS

ADJUSTING PASTURING AND CUTTING PRACTICES TO THEM

In a state in which dairying and livestock raising are dominant farm enterprises the general question of pasture and meadow management is one of the most important with which the farmer has to deal. With a scanty, sparse growth of vegetation of low nutritive value on native pastures, more expensive cultivated row crops or purchased concentrates have been resorted to and the margin of profit correspondingly reduced or perhaps eliminated. With luxurious growth of highly nutritious pasture and hay crops both feed and labor costs may be kept relatively low and more substantial profit margins realized.

In the main, efforts to increase the returns from pasture land and meadows have taken two directions or, perhaps more accurately, have approached the problem from two angles: (1) through seeding to introduce more valuable kinds of legumes and grasses and to provide a heavier stand of plants, and (2) through fertilizer applications, which, in addition to their mass effect on yield, encourage the growth of the better kinds in the stand. Much has been accomplished by these methods and there still remains a relatively large percentage of grazing land and hay fields that can be greatly benefited by their continued use. Both practices are based on the theory that the cropping of a pasture or meadow is essentially a problem in addition and subtraction. Seed is sown, fertilizers are applied and then plant tissue, produced from the seed and the fertilizer, together with water and other materials obtained from the soil, is harvested. The greater the additions of fertilizer and perhaps seed—and rainfall—the greater, theoretically at least, the subtraction in the form of crops. Because the growing plant utilizes soil moisture and many of the mineral elements in the soil, as well as the seed and fertilizer, in its growth, a pound of seed or of fertilizer may be returned two-fold or ten-fold or a hundred-fold, as the case may be.

Pasture and Meadow Management Something More than a Problem in Addition and Subtraction—This concept of crop production as a rather simple problem in addition and subtraction, basically sound so far as it goes, does not, however, present the whole picture, for it leaves out of consideration the fact that the main bulk of the plant's tissue that is removed in the crop is neither the mineral nutrients obtained from the soil nor the minute quantities of organic food materials that have migrated from the seed into the plant's leaves and stems. Instead, the main bulk of the crop—80 to 95 per cent of its dry weight—is organic matter in the form of such substances as fiber, cell wall, sugar, starch, protein, fat, pigments. These substances the plant itself must synthesize or manufacture, principally out of water from the soil and the carbon dioxide that it gets from the air, with

the aid, to be sure, of the essential mineral elements from the soil. For this manufacturing process, the plant depends almost entirely upon its leaves. With a large leaf surface food manufacture goes on rapidly (temperature, light, moisture supply and other environmental conditions being favorable); with a limited leaf surface it is correspondingly slowed down; when there are no leaves present it comes to a standstill. With ordinary field and garden and tree crops about everything one does to them in the way of culture, from cultivation and fertilizing on the one hand to pruning and spraying on the other, is for the purpose of enabling them to develop a maximum leaf surface and then protecting those leaves from injury, to the end that they may manufacture maximum amounts of such materials as starch, fats, proteins, that go to make up the crop, be that crop leaves, fruits, seeds, roots or tubers. With the pasture crop the procedure is almost the opposite in both method and effect. Ordinarily there is a continuous reduction in leaf surface and with close pasturing there is virtually complete defoliation. Figuratively speaking, this is "killing the goose that lays the golden eggs". Yet from the very nature of the case that is just what grazing must be—a steady subtraction of leaves and stems that the plant is more or less vainly producing in order to attain its normal stature and complete its growth.

Moderate vs. Close Grazing—Does this mean, then, that an acre of pasture land can yield only a small fraction of an equal area devoted to raising some field or garden crop. The answer is "no"—an answer that has been gradually worked out to their own satisfaction by thousands of observant farmers in their own fields, though probably few of them have attempted to explain their procedure in terms of starch or other root reserves. Farmers whose animals on pasture have been able "to have their cake and eat it too" have steered a kind of middle course in their grazing practice. More specifically, they have carefully refrained from too close grazing so that at all times the plants have had sufficient foliage to manufacture the food materials from which new growth can be produced. Consequently new growth has about kept pace with defoliation and both growth and defoliation processes have been maintained at a high level, because at no time were the plants permitted to become completely, or even almost, defoliated and hence too weak for recovery. It has been a matter of addition and subtraction, but those farmers have been careful not to subtract faster than the plant has added. There has been maintained at all times a good reserve "in the bank".

The basic principles of plant growth underlying this procedure are well brought out by a series of experiments conducted during recent years by the Section of Farm Crops of the Michigan Agricultural Experiment Station in which alfalfa and a number of forage grasses—including timothy, orchard grass, quack grass, brome grass and bluegrass—were clipped at various heights at suitable intervals and rates of recovery studied. Without exception close clipping (to one inch) resulted in almost complete cessation of new growth and in some instances promptly led to the death of the plants. Light clipping (to 4 or 6 inches) often, though not always, reduced somewhat the total amount of vegetation, as compared with unclipped plants, but always enabled them to recover promptly and to grow rapidly. Thus

in the case of one experiment with alfalfa plants, clipping back (the equivalent of pasturing) to 2 inches in height gave total yields equivalent to nearly 90 per cent of those allowed to grow to maturity without clipping, while clipping to a height of one inch reduced total yield to less than 15 per cent normal.

Perhaps more important than conservative spring and summer grazing in the management of pastures is special care to avoid depletion of the reserves in the roots and crowns in the fall. Studies at the Michigan Station have shown that September is a very critical month from the standpoint of how alfalfa will survive the winter and grow the next spring and summer—and this principle likewise holds for other perennial legumes and grasses, though the critical period varies somewhat with the different kinds. Under Michigan conditions close grazing at almost any time during this critical period forces the plants to use up virtually all of their reserves in making a late fall growth and then the low temperatures of October and November prevent the accumulation of new reserves of starch and sugar that will tide them through the winter and start them off in the spring. The result is much winterkilling of roots and crowns and a poor stand. On the other hand, **late** (October in the case of alfalfa) grazing, even though close, leaves the roots and crowns well-supplied with stored foods, because they are not used up in late fall growth of tops and they are in excellent condition to resume growth in the spring.

Fall Cutting of Hay Fields—Safe and Dangerous—The same principles apply to the removal of a second or third cutting of alfalfa or other hay crop during late summer or fall. Such a cutting does not harm the plants if made late enough in the season—for example early October—so that the roots and crowns are not depleted by making a subsequent fall growth, and a valuable hay crop is obtained. On the other hand, if the fall cutting is early enough so that a new flush of growth is produced in the fall, the reserve foods of roots and crowns are exhausted, the plants winterkill badly, recovery is poor in the spring, and the stand may be ruined.

The productivity of thousands of alfalfa fields in Michigan is seriously reduced and their life substantially shortened by the growers' failure to recognize these principles underlying the growth habits of the perennial pasture and forage crops and to adjust grazing and cutting practices to them. The science and art of grassland management depend to a considerable degree upon the recognition of the differences between various species. Thus, upright plants such as alfalfa and timothy are more readily defoliated by close grazing than are recumbent plants such as white clover and bluegrass. Very productive upright species prove very desirable as pasture plants, however, if grazed in accordance with their own habits of growth.

The reader who is interested in the publications based on the grazing, hay cutting and root reserve studies briefly summarized here is referred to the following:

1. Response of Quack Grass to Defoliation and Fertilization—Dexter, S. T.—Plant Physiology. **11:** 843-851. 1936.
2. The Effect of Late Summer and Early Fall Cutting on Crown Bud Formation and Winterhardiness of Alfalfa—Silkett, V. W., Megee, C. R. and Rather, H. C.—Jour. Am. Soc. Agron. **29** (1): 53-62. 1937.

3. A Study of the Time of Pasturing Alfalfa—Rather, H. C. and Dorrance, A. B.—Jour. Am. Soc. Agron. **30** (2) : 130-134. 1938.
4. Alfalfa Management, with Special Reference to Fall Treatment—Rather, H. C. and Harrison, C. M.—Mich. Agr. Exp. Sta. Sp. Bul. 292. 1938.
5. Early Cutting and Fertilization of Quack Grass Meadows—Dexter, S. T. and Clanahan, D. L.—Mich. Agr. Exp. Sta. Quart. Bul. **21** (3) : 176-179. 1939.
6. Starch Reserves in the Roots of Pastured Alfalfa when Grown Alone and in Mixtures—Rather, H. C. and Harrison, C. M.—Mich. Agr. Exp. Sta. Quart. Bul. **21** (4) : 281-291. 1939.
7. Greenhouse Studies of the Effect of Clipping the Tops of Alfalfa at Various Heights on the Production of Roots, Reserve Carbohydrates and Top Growth.—Harrison, C. M.—Plant Physiology. **14:** 505-516. 1939.
8. Responses of Certain Perennial Grasses to Cutting Treatments—Harrison, C. M. and Hodgson, C. W.—Jour. Am. Soc. Agron. **31** (5) : 418-430. 1939.

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MEASURING HYBRID CORN FOR MICHIGAN

1938-1940 TRIALS

H. C. RATHER and A. R. MARSTON
Section of Farm Crops

According to a survey made by the United States Department of Agriculture, Michigan grew some 270,000 acres of hybrid corn in 1940. Undoubtedly the acreage planted to corn hybrids in this state in 1941 will be substantially larger than that in 1940. Hence, thousands of growers are interested in the relative characteristics, yielding ability and adaptation of the scores of hybrids being offered.

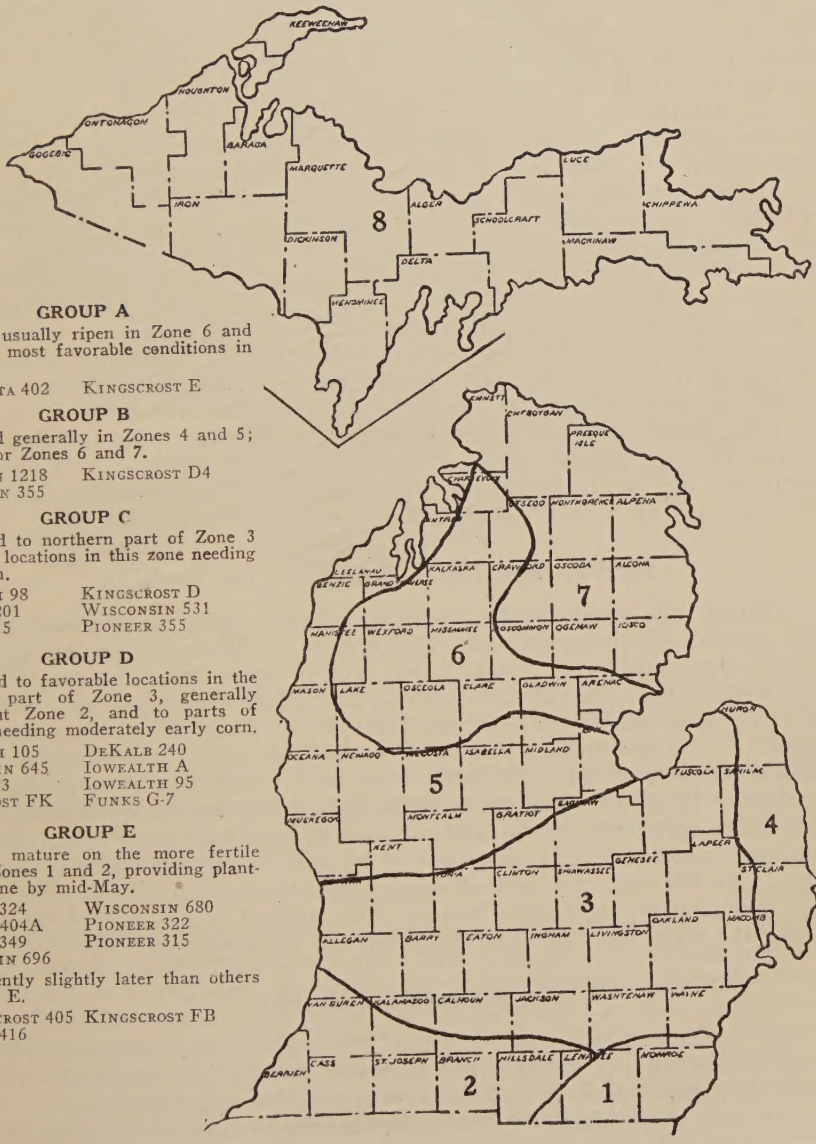
Tests under the direct supervision of the Michigan Agricultural Experiment Station are conducted each year in Monroe, St. Joseph, Ingham, Saginaw, Huron, Wexford and Otsego counties, to gain detailed information on corn hybrids, old and new, which may be of interest to Michigan corn growers. The Michigan Crop Improvement Association, county agricultural agents, farmers, and seedsmen have all contributed to the carrying on of these trials. Their diverse locations afford a reasonable representation of the range of Michigan corn growing conditions.

Method of Testing

Each variety tested at a given location appears in that test in five different places to reduce to a minimum variations in yield due to

ADAPTATION GROUPS

The corn hybrids listed below have appeared in at least one Michigan State College over-state trial in both 1939 and 1940. Its two-year average yield, in at least one trial, has been above average for all hybrids tested which were of similar maturity. The zoning of the map of Michigan is based on a study of records of normal weather during the corn growing season in this state. The adaptation of corn varieties is influenced by soil, cultural practices, and other factors besides weather so the zone divisions must be considered as general approximations rather than anything more specific.



GROUP A

Should usually ripen in Zone 6 and under the most favorable conditions in Zone 7.

MINNESOTA 402 KINGSCROST E

GROUP B

Adapted generally in Zones 4 and 5; too late for Zones 6 and 7.

MICHIGAN 1218 KINGSCROST D4
WISCONSIN 355

GROUP C

Adapted to northern part of Zone 3 and other locations in this zone needing early corn.

IOWEALTH 98 KINGSCROST D
DEKALB 201 WISCONSIN 531
OHIO M-15 PIONEER 355

GROUP D

Adapted to favorable locations in the southern part of Zone 3, generally throughout Zone 2, and to parts of Zone 1, needing moderately early corn.

IOWEALTH 105 DEKALB 240
WISCONSIN 645 IOWEALTH A
OHIO K-23 IOWEALTH 95
KINGSCROST FK FUNKS G-7

GROUP E

Should mature on the more fertile soils of Zones 1 and 2, providing planting is done by mid-May.

PIONEER 324 WISCONSIN 680
DEKALB 404A PIONEER 322
PIONEER 349 PIONEER 315
WISCONSIN 696

Apparently slightly later than others in Group E.

HOOSIERCROST 405 KINGSCROST FB
INDIANA 416

soil differences. The ear corn of each variety is sampled for moisture content four different times in the fall to make possible an estimate of the time from date of planting until the ears are down to 40% moisture. At this stage of development, according to previous work,* growth ceases and the corn may be said to have reached maturity. Dent corn at 40% moisture is fully dented and, usually, it is so hard the kernels can scarcely be cut with the thumbnail. Usually the husks will have lost their green color but the stalks and leaves may still be green and succulent. Ear corn at 40% moisture is not ready to be husked. It should contain no more than 25 to 27 per cent moisture when put into the crib. Number 2 corn on the market must contain no more than 15.5% moisture.

A variety which has not fully matured by harvest or by the time of the first killing frost will not develop its fullest potential yield even though subsequently it may dry down satisfactorily for cribbing. However, late varieties for a given location in 1940, which still contained 40% moisture or more on October 1 were subjected to very poor drying conditions in October. At East Lansing a variety which contained 52% moisture on October 2 still had 45% moisture on October 22. Another with 48% moisture on October 2 still had 39% moisture on October 22. Even corn which was down to 40% moisture on October 2 was far too wet to crib on November 1. The problem of handling soft corn was very prevalent in the fall of 1940, whereas in 1938 and 1939 even late varieties dried early and rapidly.

Corn should at least be early enough to mature fully and dry safely in the average season. Some hybrids are being offered in Michigan in localities for which they are too late. They seemed satisfactory in 1939 and brought only trouble and dissatisfaction in 1940.

Hybrid Seed Not a Substitute for Fertility

During the 1940 season the Farm Crops Section received numerous reports of dissatisfaction with the productivity of certain hybrids. Ears were small and poorly filled, yields were low. The authors do not believe that any of the hybrids are inherently that bad. No kind of seed is a substitute for soil fertility or favorable seasonal conditions. If the productive level of a corn field is such that only a 25- or 30-bushel crop can be produced that field presents no particular seed problem. What the field needs is barnyard manure, a leguminous crop, and some fertilizer—or possibly it should never be used for corn. Under such conditions even the best of hybrids is certain to be disappointing. A fertile soil, the best of cultural practices, and a favorable season are essential to high corn yields. An adapted vigorous hybrid should make the most of favorable conditions of environment.

Interpreting Results

In the tables presented here, the yields of the varieties tested in 1940 are given. If these same varieties were also tested in 1939 and 1938 their two- and three-year average yields are given.

No one experiment in a single season, regardless of how well it

*Rather, H. C., and Marston, A. R.—A study of corn maturity, Mich. Agr. Exp. Sta. Quart. Bul. **22** (4): 278-288. May, 1940.

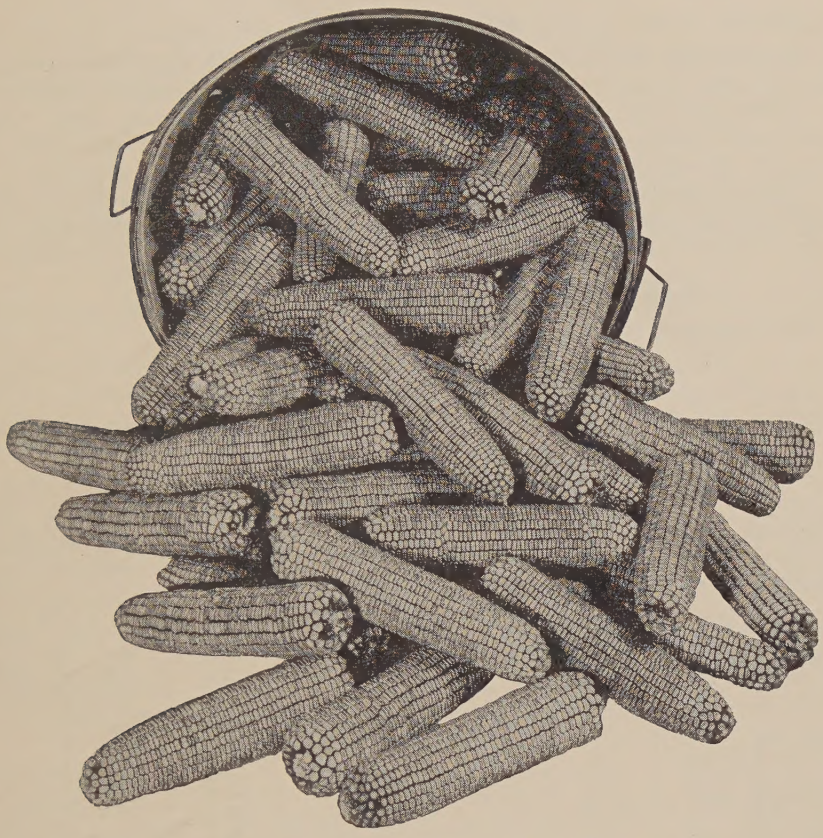


Fig. 1. Wisconsin Hybrid No. 645.

has been conducted, yields evidence which is fully conclusive with respect either to yield or maturity. The information concerning varieties tested only in 1940 is presented with full appreciation of the shortcomings of a single trial. **The most dependable information in this report is that based on three-year average performances.**

All yields are expressed in bushels of shelled corn at a uniform moisture content of 15.5%.

Maturity

The one satisfactory way of determining the adaptation of a new variety is to compare its performance with other corns of known merit. The varieties tested are listed in the accompanying tables, in their order of maturity with the earlier corns heading the list. Additional information gained in subsequent years may result in some changes in this arrangement, but the authors are confident that the earliest corns are near the top and the latest near the bottom of each list. Hybrids apparently of similar maturity have been grouped. In general, there is a range of about five days between the earliest and latest corn within each group.

MONROE COUNTY

For the last three years the Monroe tests have been conducted on the Monroe county farm, Walter Kraus, superintendent. The area for 1940 consisted of a rather uniform, level, sandy loam field. There was some infestation by the European corn borer but this difficulty was not of sufficient consequence materially to affect the yield.

Possibly some of the earliest varieties tested here are earlier than necessary for the better soils of southeastern Michigan, although Ohio K-23 in particular has given an excellent three-year performance.

Table 1. Yields of varieties tested in Monroe County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Minnesota 403	58.4		
DeKalb 240	55.2		
WISCONSIN 605	60.0	64.3	63.7
Wisconsin 645	60.0		
Iowealth A	56.2	68.9	
Kingscrost 176	57.2		
OHIO K-23	67.3	70.1	69.4
Ohio K-35	61.0		
DUNCAN, O.P.	44.1	53.5	55.7
Funks' G-7	65.1	69.1	
DE KALB 202	57.5	60.6	62.7
KINGSCROST FK	57.2	66.0	66.5
Pioneer 324	58.4	73.6	
Wisconsin 678	61.9	67.7	
Wisconsin 680	69.2		
Funks' G-18	59.7		
WISCONSIN 696	65.1	71.3	72.8
DeKalb 410	66.4		
Michigan 21A	53.0		
DeKalb 404A	57.8	66.5	
WISCONSIN 676	54.9	65.7	68.2
PIONEER 322	64.5	70.9	78.2
Pioneer 315	63.8		
Hoosiercrost 405	61.9	74.4	
DeKalb 615	69.5		
Pioneer 330	51.1		
M & M 554	69.2		
IOWEALTH 100	58.1	68.6	67.9
INDIANA 416	49.0	70.1	75.4
KINGSCROST FB	66.7	73.4	69.1
Bender 348	45.4		
Iowealth AB	63.5	70.9	
Wisconsin 690	52.1		
Indiana 420	57.5		
Indiana 425	57.8		
Kingscrost KY	59.1		
Hoosiercrost 422	69.5	79.4	
Iowealth B	70.5	77.6	
National 116	63.5	76.9	
Pioneer 3307	57.8		
Indiana 610	66.4		
Hoosiercrost 461	59.7	69.6	
Hoosiercrost 668	60.0		
Red Cob Ensilage, O.P.	36.5		

Planting dates: 1938—June 2
1939—May 15
1940—May 20

Harvest dates: 1938—Oct. 14
1939—Sept. 27
1940—Sept. 30

None of the later varieties has shown significant yield advantages over the leaders in the second group and use of these later corns increases soft corn hazards.

ST. JOSEPH COUNTY

In St. Joseph county these trials were conducted on the farm of Robert Robinson, near Mendon. Exceptionally favorable conditions prevailed in 1939 when yields in excess of 100 bushels shelled corn

Table 2. Yields of varieties tested in St. Joseph County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Minnesota 403	53.3		
DeKalb 240	55.2	79.5	
DeKalb 204	54.6		
IOWEALTH 105	49.5	79.4	77.3
WISCONSIN 606	43.2	68.8	63.4
WISCONSIN 645	48.3	72.4	71.1
Kingscrost 176	50.5		
OHIO K-23	62.2	84.4	77.2
Ohio K-35	54.9		
DUNCAN, O.P.	44.4	69.8	63.4
Iowealth A2	44.4	72.3	
Funks' G-7	42.5	71.6	
DeKalb (Exp. 42)	48.9		
Fair's Yellow Dent, O.P.	50.8		
KINGSCROST FK	53.0	75.0	70.6
Pioneer 324	61.6	86.1	
Wisconsin 678	56.5	79.9	
WISCONSIN 680	61.6	84.6	79.3
Funks' G-18	43.8		
Michigan Wonder, O.P.	45.7		
WISCONSIN 696	52.1	78.7	76.1
DeKalb 410	53.7		
Michigan 21A	45.0		
KINGSCROST FB	53.7	79.3	73.8
DeKalb 404A	51.4	82.9	
WISCONSIN 676	52.1	76.2	75.2
PIONEER 322	49.2	82.6	80.3
Pioneer 3314	56.2		
Pioneer 315	48.9	84.2	
PIONEER 349	56.5	83.1	79.7
Hoosiercrost 405	45.7	73.7	
INDIANA 416	55.2	83.4	86.6
Indiana 610	57.8		
Bender 348	49.8	84.0	
Iowealth AB	49.2	74.8	
Wisconsin 690	55.2		
Indiana 420	53.7		
Indiana 425	51.4		
Kingscrost KY	41.0		
Hoosiercrost 422	54.3	83.2	
Bender 14	43.5		
Iowealth B	45.4	77.5	
National 116	45.4		
Hoosiercrost 461	42.2	75.3	
Hoosiercrost 668	58.7		
Red Cob Ensilage	34.3		

Planting dates: 1938—May 12
1939—May 17
1940—May 21

Harvest dates: 1938—Oct. 11
1939—Oct. 2
1940—Oct. 10

to the acre were produced. In 1940 the trials were in a much less productive field but comparisons were satisfactory. A killing frost occurred September 26 in 1940. At harvest time, two weeks later, all but one of the varieties in the two latest groups still contained 40% moisture or more. It was of interest to the authors that the later varieties were at a yield disadvantage in 1940, the average for the earliest group being 51.2 bushels an acre, for the intermediate group, 51.8 bushels an acre and for the latest two groups 47.1 bushels an acre. The highest yield in 1940 in the St. Joseph trials was obtained with Ohio K-23, a hybrid amply early for this area. This hybrid has also shown to advantage in the Monroe and Ingham county trials on a three-year basis.

Table 3. Yields of varieties tested in Ingham County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Michigan 71A	45.1		
Minnesota 401	58.4		
Michigan (Exp. 70233)	64.1		
Kingscrost KN121	61.6		
Iowealth W-16	56.2	64.6	
Wisconsin 355	51.1		
Minnesota 600	57.5		
Iowealth W-12	54.3		
MICHIGAN 1218	52.7	63.1	59.2
Wisconsin 460	59.1		
Kingscrost KN5	65.7		
KINGSCROST D	64.8	66.7	63.5
WISCONSIN 531	56.5	66.0	61.7
PICKETT O.P.	47.6	55.6	52.1
PIONEER 355	67.3	71.2	64.7
Kingscrost KN2	70.2		
Ohio M-15	77.5	75.4	
OHIO K-23	74.6	73.1	65.6
WISCONSIN 525	57.2	60.8	58.3
DUNCAN, O.P.	52.4	55.2	54.5
IOWEALTH 95	67.6	72.4	64.2
KINGSCROST FK	77.2	73.3	67.6
FUNKS' G-7	69.2	71.8	70.8
DeKalb 240	65.4	67.9	
Minnesota 403	62.2		
Pioneer 353	74.9		
WISCONSIN 645	59.7	69.3	66.1
DeKalb 204	65.7		
DeKalb 404A	69.5	72.2	
Michigan 21A	65.7		
Funks' G-18	71.1		
PIONEER 322	80.0	78.2	71.2
Pioneer 3530	68.9		
DeKalb 225	63.2	70.1	
Iowealth AB	68.9	71.7	

Planting dates: 1938—May 11
1939—May 12
1940—May 11

Harvest dates: 1938—Oct. 20
1939—Oct. 4
1940—Oct. 4

INGHAM COUNTY

The Ingham county trials, conducted for the last three years on the Michigan State College farm at East Lansing, have been favored by good soil and early planting. A full crop of soybeans was plowed under for the 1940 crop, furnishing an abundance of organic matter. Hybrids as early as, or earlier than, Michigan 1218 have been earlier than necessary for these circumstances although an excellent yield was obtained in 1940 with an experimental Michigan hybrid, No. 70233.

Ohio M-15, according to Michigan observations and reports from the Ohio Experiment Station is slightly earlier than Ohio K-23 and has given very satisfactory yields for two years in the East Lansing trials. Kingscrost D, Pioneer 355 and Wisconsin 531 appear early enough for late May plantings at East Lansing and each has done well for three years. Hybrids as late as Wisconsin 645 may be a little too late in Ingham county unless seasonal conditions are unusually favorable while still later hybrids, though weighing up well, were not fully mature and in some of the later plantings at this station were very soft in 1940.

Table 4. Yields of varieties tested in Saginaw County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Wisconsin 279	39.4		
Michigan 71A	34.0		
Minnesota 401	43.7		
Wisconsin 355	49.0	51.6	
Wisconsin 330	38.9		
Michigan (Exp. 70233)	57.9		
Kingscrost D4	47.5	53.8	
Kingscrost KN5	55.1		
Minnesota 600	49.3		
DeKalb 78	53.1		
MICHIGAN 1218	47.8	54.5	58.1
Wisconsin 460	48.8		
KINGSCROST D	53.1	55.7	60.9
Kingscrost KN2	47.2		
PICKETT, O.P.	42.9	50.4	54.1
Iowealth 98	55.9	61.4	
DeKalb 201	53.6	62.0	
WISCONSIN 531	52.6	55.9	63.0
Pioneer 355	59.2		
Ohio M-15	63.2		
Pioneer 370	65.8		
WISCONSIN 525	47.2	53.3	58.8
Iowealth 95	55.4	59.6	
Michigan 21A	64.3		
Pioneer 353	61.2		
Pioneer 357	62.7		
DeKalb 225	54.1	65.0	

Planting dates: 1938—May 17
1939—May 18
1940—May 15

Harvest dates: 1938—Oct. 6
1939—Sept. 26
1940—Sept. 26

SAGINAW COUNTY

The Saginaw county trials were conducted on the Herbert Schmeige farm near Chesaning. The European corn borer infestation was bad in this trial but, fortunately, there were no high winds to break the corn over. Plants were found with as many as 50 borers and these fell over with a light push. The earlier varieties in particular suffered in yield from borer infestation.

Wisconsin 531 leads this trial on the basis of three-year averages while Michigan 1218, somewhat earlier, has a very good three-year record. It is doubtful whether any hybrids later than Ohio M-15 should be used in this area and even this hybrid may require favorable conditions to reach full maturity.

HURON COUNTY

The Huron county trials were plagued by a severe hailstorm in 1939 and very severe European corn borer damage in 1940. Conducted on the Herbert Gettel farm north of Pigeon, the soil conditions have

Fig. 2. Michigan Hybrid No. 1218.

been excellent. The corn yields were much below the potential productivity of this soil in both the last two seasons. In 1940 as many as 90% of the stalks of some plats were broken by borer damage. There was no consistent varietal advantages in this respect.

Wisconsin 355 seems earlier than necessary for some conditions in this locality, and about right for late May planting or growth on the less fertile soils. Michigan 1218 did poorly in 1940 but has been one of the better hybrids for this location in other years. Its chief disadvantage is in strength of stalk, being more comparable with Pickett corn in this respect. It has consistently out-yielded the Pickett variety. A Pioneer hybrid, No. 3370, showed considerable promise in 1940.

Table 5. Yields of varieties tested in Huron County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939-40 average	1938-39-40 average
Wisconsin 279	37.5		
Wisconsin 275	37.1		
Michigan 71A	29.5		
Kingscrost A3	37.5	38.8	
Kingscrost D4	41.6	45.6	
Kingscrost 108	40.3		
Wisconsin 330	32.4		
WISCONSIN 355	34.0	34.4	45.8
Minnesota 401	41.6		
Minnesota 600	39.7		
Michigan (70233)	41.9		
Kingscrost D	46.0		
PICKETT, O.P.	30.8	33.8	45.7
MICHIGAN 1218	31.8	35.5	49.4
Pioneer 3370	57.5		
WISCONSIN 531	40.0	40.6	52.0
Pioneer 355	46.7		
Ohio M-15	54.3		
Iowealth 95	53.7		
Michigan 21A	42.9		
Pioneer 357	40.6		
DeKalb 201	41.6	42.1	
Iowealth 98	41.6	48.9	
DeKalb 240	44.5		

Planting dates: 1938—May 18
1939—May 22
1940—May 18

Harvest dates: 1938—Oct. 4
1939—Oct. 12
1940—Oct. 3

NORTHERN MICHIGAN

Results of trials in Wexford and Otsego counties have been comparable. These have been conducted on the farms of William Franke, Tustin, in Wexford county and Tom Millbocker in Otsego county.

None of the corns tested has been able to mature consistently at either of these locations, the three-year average moisture content at

Table 6. Yields of varieties tested in Wexford County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Kingscrost 125	40.0		
NORTHWESTERN DENT, O.P.	27.0	38.9	31.7
KINGSCROST E	36.2	45.7	37.9
Wisconsin 279	38.4		
MINNESOTA 402	39.1	49.6	39.4
Wisconsin 275	40.0		
Wisconsin No. 25, O.P.	42.9		
Michigan 71A	37.8		
Minnesota 401	43.2		
Wisconsin 330	34.3		
Kingscrost A3	45.1		
Wisconsin 355	42.5	53.9	
DeKalb 66	36.5		
Michigan (Exp. 70233)	39.1		
Iowealth 91	34.9	50.6	
Iowealth W-16	37.5		
MICHIGAN 1218	40.0	50.4	42.1
Pioneer 355	35.2		
DeKalb 201	38.1	53.9	
Pioneer 357	35.6		
Michigan 21A	25.7		
Pioneer 3370	26.0		

Planting dates: 1938—May 23
1939—May 19
1940—May 14

Harvest dates: 1938—Oct. 13
1939—Sept. 20
1940—Oct. 7

Table 7. Yield of varieties tested in Otsego County.

Variety	Yield (Bushels per Acre)		
	1940 only	1939–40 average	1938–39–40 average
Kingscrost 125	40.6		
NORTHWESTERN DENT, O.P.	30.2	32.4	30.2
MINNESOTA 402	43.2	45.0	41.4
Wisconsin 275	44.8		
Michigan 71A	40.6		
WISCONSIN NO. 25, O.P.	46.0	47.4	41.5
Kingscrost A-3	45.7		
KINGSCROST E	38.1	42.2	37.0
Wisconsin 279	37.8		
WISCONSIN 355	40.0	46.0	42.3
Wisconsin 330	43.2		
Michigan (Exp. 70233)	48.3		
MICHIGAN 1218	44.5	44.6	40.3
Iowealth 91	41.0	45.9	
Iowealth W-16	32.1		
Pioneer 355	40.6		
Pioneer 3370	29.8		
Michigan 21A	37.1		
DeKalb 240	33.7		

Planting dates: 1938—May 24
1939—May 20
1940—May 22

Harvest dates: 1938—Oct. 12
1939—Oct. 10
1940—Oct. 8

harvest for each of them being in excess of 40%. Minnesota 402 has been as satisfactory as any in tests which cover a five-year period. Kingscrost E has a very good three-year record and is a pure yellow dent whereas Minnesota 402 is mixed yellow and white. Wisconsin hybrids 275 and 279 appeared promising in 1940 trials and have given excellent results in northern Wisconsin.

Fig. 3. Minnesota Hybrid No. 402.

SUPPLEMENTARY TRIALS

By A. A. JOHNSON

In addition to the seven major over-state corn trials conducted in Michigan, ten supplementary trials were carried on in 1940. In general, varieties were chosen for these trials which had already shown some promise. At each location at least one variety too early for the area and one later than is desirable were included for demonstration purposes.

The plot layout consisted of five blocks in which the varieties were distributed at random. Thus each variety appeared in the test five times. In addition, a check variety was planted every fifth plot to aid in making accurate comparisons.

In the following tables the yield results are reported for each test with varieties listed in order of maturity. Information with respect to relative maturity is based on records in other trials covering a period of years in addition to performance in 1940. Three trials were abandoned because of irregularities in the field.

Lenawee County.

Planting date, May 22	Date harvested, October 17

Variety	Yield (Bushels per Acre)
Wisconsin 531	63.8
Wisconsin 606	70.1
Wisconsin 645	72.1
Ohio K-23	70.9
Duncan O.P.	56.2
DeKalb 204	66.1
Kingscrost FK	68.7
Woodburns, O.P.	50.1
Michigan 21A	61.3
DeKalb 404A	79.9
Pioneer 322	74.0
Pioneer 349	75.1
Funks' G-8	71.4
Pfister 368	79.5
Ohio W-17	81.6
Indiana 416	77.1
Pfister 266	76.8
Pioneer 307	79.3
DeKalb 606	83.1
Funks' G-66	74.7

The Lenawee County plot was conducted on the farm of Felix Witt, Jasper. The test area was on a uniform, level field, consisting of a clay loam soil. Most of the varieties in this trial were drying satisfactorily by the harvest date, October 17. The moisture content of the ears at harvest of those varieties in the last maturity group was, however, still well in excess of 30%, when the corn should have been dry enough for cribbing. There was a severe infestation of European corn borer in this plot. No varieties showed any inherent resistance

Branch County.

Planting date, May 18	Harvest date, October 11
Variety	Yield (Bushels per Acre)
Michigan 1218	48.8
Pickett, O.P.	46.3
Wisconsin 531	52.7
Wisconsin 606	58.9
Wisconsin 645	62.6
Ohio K-23	57.2
Kingscrost FK	61.2
DeKalb 204	56.6
Bowens, O.P.	59.1
Michigan 21A	49.8
DeKalb 404A	63.3
Pioneer 322	61.6
Pfister 368	58.2
Indiana 416	58.3
Pfister 266	54.7

to borer attack. The later maturing varieties escaped severe borer infestation and thus had a higher percentage of erect plants.

The Branch County plot was conducted on the farm of Fred Dunks, Union City. The test plot was located on fairly uniform sandy loam soil. Heavy frosts occurred about Sept. 26, 1940, stopping growth on all varieties in the plat. Varieties in the last two maturity groupings show no yield advantage over those in the second maturity grouping and, as a group, carried a higher moisture percentage in the ears at harvest.

This plot, conducted on the Upjohn-Richland farm, Richland, was located on a uniform, productive clay loam soil. Frosts of September

Kalamazoo County.

Planting date, May 21	Harvest date, October 16
Variety	Yield (Bushels per Acre)
Wisconsin 355	63.9
Cornell 29-3	65.8
Pickett, O.P.	61.5
DeKalb 201	77.1
Wisconsin 531	68.9
Wisconsin 606	78.3
Wisconsin 645	82.7
Ohio K-23	78.8
Kingscrost FK	72.2
DeKalb 202	70.5
Michigan 21A	66.8
DeKalb 404A	80.1
Pioneer 322	81.1
Indiana 416	89.3
Hoosiercrost 461	83.9

26 were less severe in the Kalamazoo County plot than was the case in Branch County. Consequently the later maturing varieties, notably Indiana 416, continued to develop until a more severe frost occurred in the second week of October. On basis of this year's plot, maturity and yields considered, there is little or no advantage in choosing a variety later than from those in the third maturity group.

Jackson County.

Planting date, May 16	Harvest date, October 10
Variety	Yield (Bushels per Acre)
Wisconsin 355	51.2
Michigan 1218	41.1
Pickett, O.P.	42.5
DeKalb 201	51.1
Wisconsin 531	47.8
Pioneer 355	52.0
Ohio M-15	58.0
Wisconsin 606	50.7
Duncan, O.P.	35.3
Wisconsin 645	53.6
Ohio K-23	57.5
DeKalb 204	53.1
Michigan 21A	53.7
Pioneer 322	60.7
Indiana 416	61.6

The Jackson County plot was conducted on the farm of George House, Jackson, with the Jackson County Crop Improvement Association cooperating. The test area was in a slightly rolling field, consisting of a sandy loam soil. Considering both yield and maturity, Ohio M-15 and Ohio K-23 gave the best performance in this plot.

The Montcalm County plot was conducted on the farm of Kenneth Knapp, Coral. This plot was located in a field consisting of a produc-

Montcalm County.

Planting date, May 17	Date harvested, October 7
Variety	Yield (Bushels per Acre)
Minnesota 402	45.1
Wisconsin 355	49.2
Michigan 1218	51.8
Pickett, O.P.	51.1
Kingscrost D	55.6
DeKalb 201	48.5
Wisconsin 531	59.7
Wisconsin 645	55.6
Pioneer 322	49.6

tive uniform sandy loam soil. Maximum yields of sound corn were obtained from varieties as early as or earlier than Wisconsin 531. The two latest varieties were not mature at harvest time.

Sanilac County.

Planting date, May 23	Date harvested, October 7
Variety	Yield (Bushels per Acre)
Minnesota 402	32.3
Kingscrost E	26.6
Wisconsin 355	32.8
Michigan 1218	33.9
Pickett, O.P.	24.9
Kingscrost D	34.3
DeKalb 201	39.0
Wisconsin 531	36.2
Wisconsin 645	40.9
DeKalb 201	46.6

The Sanilac County plot was conducted on the farm of Ed Frances, Peck. The ears of all varieties as late as Pickett and later exceeded 40% moisture at the harvest date of October 7. The earlier varieties in this plot suffered in yield from attack by the European corn borer.

Isabella County.

Planting date, May 14	Date harvested, September 23
Variety	Yield (Bushels per Acre)
Minnesota 402	32.3
Kingscrost E	24.7
Wisconsin 355	37.9
Golden Glow, O.P.	31.1
Michigan 1218	30.9
Kingscrost D	38.8
DeKalb 201	46.5
Wisconsin 531	42.4
Wisconsin 645	45.4
Michigan 21A	38.1

The Isabella County plot was conducted on the farm of Earl Bayes, Shepherd. This plot was located in a level field consisting of clay loam soil. This plot was planted early (May 14) and all varieties earlier than Wisconsin 645 were ripe or nearly so on the harvest date of September 23. There was considerable damage from the European corn borer in this plot.

The Clare County plot was conducted on the farm of Lowell Penrose, Clare. This plot was in a fairly uniform field consisting of loam

Clare County.

Planting date, June 3	Date harvested, October 4
Variety	Yield (Bushels per Acre)
Minnesota 402	38.7
Kingscrost E	28.5
Wisconsin 355	41.6
Golden Glow, O.P.	36.7
Wisconsin 404	42.4
Michigan 1218	35.9
Kingscrost D	43.4
DeKalb 201	40.3
Wisconsin 531	40.9
Wisconsin 645	40.3

soil. This plot was planted late, June 3, and Minnesota 402 and Kingscrost E were nearest ripe at harvest time. The ears of all other varieties were very immature, containing 50% moisture or more.

Leelanau County.

Planting date, May 23	Date harvested, October 8
Variety	Yield (Bushels per Acre)
Minnesota 402	41.5
Kingscrost E	31.9
Wisconsin 355	48.9
Golden Glow, O.P.	43.1
Michigan 1218	39.6
Kingscrost D	43.5
DeKalb 201	45.6
Wisconsin 531	40.5
Pioneer 355	40.1
Wisconsin 645	30.8

The Leelanau County plot was conducted on the farm of the Kahrs Bros., Suttons Bay. The test area was located on a rolling productive field. None of the varieties in this plot had attained maturity (40% moisture) at the date on which this plot was harvested.

The Cheboygan County plot was located on the farm of Alex Weiss, Levering. The plot was located on a rolling field consisting of sandy loam soil. None of the varieties in this plot was mature (40% moisture) on the harvest date, October 9.

Cheboygan County.

Planting date, May 24	Date harvested, October 9
Variety	Yield (Bushels per Acre)
Northwestern Dent, O.P.	24.6
Minnesota 402	33.9
Kingscrost E	33.4
Michigan 71A	33.4
Wisconsin 355	41.3
Kingscrost A3	32.1
Golden Glow, O.P.	25.1

SPRAYS TO CONTROL THE SCOTCH PINE SCALE, *TOUMEYELLA NUMISMATICUM*

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Early in 1940 a heavy infestation of the Scotch pine scale, *Toumeyella numismaticum,* on a large uniform planting of jack pine, presented an ideal set-up for experimental work. The infestation was of about five years standing and affected every tree. Characteristically, the heavy infestation was greatest on the lower branches and from the tips of the twigs back onto the three- and four-year growth.

The stand was divided into 11 plots and sprayed with the combinations indicated in the accompanying tabular presentation. The first 10 plots were of 20 trees each, whereas the eleventh contained approximately 800 trees and served as a check, inasmuch as 4 per cent bordeaux-oil emulsion has been previously reported as controlling *Toumeyella numismaticum.*

1. One gallon oil—vis.* 108 containing 4.6 oz.** DNOCHP†
2. One gallon oil—vis. 108 containing 4.6 oz. DNOC††
3. One gallon oil—vis. 87 containing 4.6 oz. DNOCHP
4. One gallon oil—vis. 52 containing 4.6 oz. DNOCHP
5. 8 oz. DNOCHP plus 12 oz. lye (94% NaOH)
6. 16 oz. DNOCHP plus 12 oz. lye (94% NaOH)
7. 8 oz. DNOCHP plus 12 oz. lye (94% NaOH)
8. 16 oz. DNOCHP plus 12 oz. lye (94% NaOH)
9. 8 oz. DNOC plus 12 oz. lye (94% NaOH)
10. 16 oz. DNOC plus 12 oz. lye (94% NaOH)
11. 4 gallons oil vis. 108 emulsified with ½-½-100 bordeaux (Check, 800 trees)

The sprays were applied between April 10 and 17. At that time the scales were showing signs of life. A power rig was used which gave 600 pounds pressure at the nozzle. Particular care was exercised to cover the lower branches and tips of the twigs.

*Vis. = Viscosity Saybolt 100° F.
**Indicated amounts added to 100 gallons water.
†DNOCHP = Dinitro-orthocyclohexyl-phenol.
††DNOC = Dinitro cresol.
Spray materials 5-10 inclusive prepared by grinding with bentonite.

To determine the effectiveness of the sprays the trees were checked July 15, 1940. Four branches from 10 trees in each plot were selected at random and all scales were counted on 2-foot lengths of each branch selected. (Branches were selected from the four sides of each tree.)

At the time the checks were made the only live individuals of *Toumeyella numismaticum* to be found were upon occasional branches, obviously missed by the spray. In all instances, the sprays were 100 per cent effective when the scales were hit.

In no instance did any of the sprays cause injury to jack pine, even in instances where the trees were weakened as result of the heavy infestation of *Toumeyella numismaticum.*

A SUGGESTED PROGRAM FOR THE CONTROL OF BOVINE MASTITIS IN MICHIGAN

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The mastitis control program is available to every dairyman of Michigan. There are no rules, regulations, or agreements to sign. It is the responsibility of each dairyman to see that the testing is properly carried out and to see that certain essential sanitary measures are adopted in handling the herd if the program is to accomplish anything in his dairy herd.

The conditions that exist on each dairy farm, peculiar to that individual herd, make it impossible to give an exacting blanket mastitis control program that will apply in each case. For that reason the author recommends that each dairyman consult his local veterinarian. Many veterinarians are equipped to make a microscopic test of milk samples for streptococcic mastitis.

Mastitis vials, containing the differential preservative, for use in submitting milk samples for test can be obtained from Dr. H. H. Ruhland of the Animal Pathology Department of the College. A 2-cent charge is made for each vial. An additional 8 cents is charged for each sample when the milk is submitted for test. This makes a total of 10 cents per cow for testing inasmuch as one composite sample is submitted from each cow.

The Proper Collection of Milk Samples for Test

Milk samples must be properly collected and handled if the test results are to be of any value. Only milk samples from lactating cows can be tested with any degree of accuracy. Strict adherence to the following procedure will yield milk samples satisfactory for testing:

1. **Do not collect samples within a period of two hours after milking—**Approximately 50 per cent of the infected cows give a negative test when samples are collected too soon after milking the animals. Apparently the streptococci in the milk cistern and ducts of the udder

are completely flushed out with the milk, and usually are not replaced by bacteria from the deeper regions of the udder until near the end of the two-hour period.

2. **Wash udders and teats with chlorine solution (200-400 p. p. m.)—** This procedure is important in excluding from the sample the fecal streptococci that are normally present in the manure and that look just like the mastitis streptococci. The chlorine kills the bacteria on the udders and teats wiped, thereby excluding these confusing bacteria from the milk sample to be tested.

3. **Discard the first two streams of milk from each quarter into a strip cup—**This is essential for flushing away any dirt and bacteria that may be on the end of the teat. Failure to discard the fore-milk may introduce contaminating bacteria that will interfere with the accuracy of the microscopic test results.

4. **Collect a 5-cubic centimeter (fill mastitis vial slightly more than half full) cow composite sample by milking directly into the vial containing the differential preservative, being careful not to touch the part of cork that goes into the tube. Label the vial—**If milk is submitted from only three quarters of a cow and a negative test result is obtained the infection in the fourth quarter is missed. This infection causes the fourth quarter to produce less milk and butterfat, milk of abnormal appearance, or may be responsible for that quarter being "blind" or non-functional. A small amount of milk or secretion from each of the four quarters must be included if the test results are accurately to indicate the status of the cow.

5. **The person collecting milk samples must wash his hands in chlorine solution (200-400 p. p. m.) prior to sampling each cow—**This is essential to prevent the contamination of milk samples with bacteria from his own person or bacteria from a previously sampled infected cow.

6. **Fill in all portions of the mastitis report and send it with the milk samples—**This information is essential to interpret accurately the results of the test and thereby arrive at a diagnosis. The "months since calving" and "record of udder injury" aid in determining whether an increase in the leucocyte content of milk is a result of physiological or pathological processes. Any past or present changes in the udder or milk should be recorded, for this information is essential in determining the cause of acute cases of mastitis. Staphylococci, *Escherichia coli* or streptococci may be the causative factor in acute mastitis. If staphylococci and *Esch. coli* are noted on microscopic examination of incubated milk and a history of trouble is recorded, a definite diagnosis can be made of these forms of infectious mastitis.

The Frequency of Testing Cows for Mastitis

The number of times that the herd should be tested will depend on the individual dairy herd. A suggested plan is to test at monthly intervals for three months, every other month for about eight months and at about 90 day intervals thereafter. The tendency is to allow too great an interval of time between tests. This is unfortunate for

not all cows of the herd are lactating at any one time and only milk from lactating cows can be tested with any degree of accuracy, and if infection does gain entrance to the herd, it may spread and do much damage before its presence is detected.

Recommendations for the Prevention and Control of Mastitis

1. **Consult your local veterinarian**—The specific conditions existent on each dairy farm require expert knowledge for the proper application of preventative and control methods of handling the dairy herd.

2. **Test the herd to locate the infected cows**—A physical examination should be made of the udder of each cow and a microscopic test should be made of the milk of each lactating cow of the herd to determine the exact status of every cow. The methods of control to be applied depend, in part, on the number of infected cows in the herd and a consideration of their economic value.

3. **Dispose of the badly infected cows, detected by physical examination, for slaughter**—These cows are not efficient milk producers owing to the scar tissue in the udder. The scar tissue forms in the udder of the infected cow at the expense of secreting tissue and through a replacement process greatly reduces the milk-secreting ability of the cow.

4. **Segregate infected cows, detected by microscopic test, at one end of the milking line or in another stable until they are removed from the herd**—Some of these cows may still be profitable because of the amount of milk they produce but they must be handled as infected cows to prevent further spread of the infection in the herd. Therefore, the sanitary measures suggested in 10 must be practiced at all times.

5. **Upon removal of infected cows from the herd, their stalls must be cleaned**—All manure and dirt must be mechanically removed by scraping, followed by a thorough scrubbing with a lye solution. Superphosphate or lime may be applied to the floor because they exert a marked germicidal action against the bacteria that cause infectious mastitis.

6. **Test all replacement cows before purchase or buy them subject to such test**—(Isolate until tested). It is obvious that only non-infected replacement animals should be added to the herd.

7. **Procedures must be practiced in raising heifer calves to prevent udder injury and to prevent the sucking that breaks the seal on the teats if they are to be used as good replacement cows**—The bacteria that cause infectious mastitis invade the mature or immature udder through the normal teat canal upon repeated exposure or through injuries of the udder or teats. The infection is kept out by the unbroken skin of the udder and the normal unmolested seal of the teat in the heifer.

8. **Stable cows in properly constructed stalls or stanchions with plenty of clean bedding to prevent udder injuries**—The prevention of udder injuries is responsible for removing one avenue for entrance of the infecting bacteria into the udder.

9. **All injuries, especially those occurring on the udder and teats, must be properly treated to prevent marked defacement or further complications of the injured part**—Veterinary aid should be obtained in the care of udder and teat injuries.

10. **Employ the following sanitary measures in the barn at all times:**

a. Before milking, wipe the udder of each cow with a clean cloth moistened with chlorine solution (200 p. p. m.).
b. Discard the fore milk into a strip cup.
c. In hand milking, wash hands before milking each cow.
d. Exclude people with "running sores" on their hands or "strep" throats from the milking of cows.
e. In machine milking, dip teat cups into two separate pails of chlorine solution (200-400 p. p. m.) before milking each cow.
f. Do not permit a calf to nurse in the milking line.
g. Use superphosphate or lime on the pavements and platforms.
h. Permit plenty of sunshine to enter the barn.
i. Milk infected cows last and properly dispose of their milk.

The application of these procedures is essential in the prevention and control of mastitis in the dairy herd. In addition, the milk produced under these conditions will be of much higher quality than where these sanitary measures are not employed.

11. **Proper preventive vaccination may be of value where the infected cows must remain in the herd for some time**—The proper use of vaccines and bacterins can result in no harm but on the other hand only a trial will indicate if any good can come from their use in the individual herd. It is recommended that the dairyman consult his local veterinarian concerning this matter.

To eradicate the disease from the herd it is necessary to eliminate all infected cows, including those not yet in the advanced stages of mastitis.

CARROTS USED FOR GREEN FEED SUBSTITUTE

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During 1938-39 a comparison of carrots, dehydrated alfalfa leaf meal, and "Greenmelk" a commercial preparation, composed of dehydrated cereal grass and condensed milk by-products, was carried on at the Upper Peninsula Experiment Station. These materials were used principally as a source of carotene, which is essential for the production of vitamin A in the nutrition of the animal. A report of this trial will be found in the February 1940 issue of the Quarterly Bulletin of this Station.

In the early part of the trial an unusually large quantity of carrots were consumed, owing to increasing the palatability of the carrots by cooking. At one time the consumption was in excess of 10 pounds per hundred birds per day, which is more than one-third of the quantity of feed usually consumed by 100 birds of the White Leghorn breed. The egg production was lower for the entire period, where carrots were fed. The consumption of carrots to the exclusion of other essential feedstuffs, in sufficient quantities, might explain the lower production. The vitamin A content of the livers from the birds fed carrots was higher than from birds in either the alfalfa-fed or "Greenmelk"-fed pens, and the egg yolks contained a reasonable amount of vitamin A where carrots were fed. Those receiving alfalfa gradually reduced the amount of vitamin A in the yolks. It was thought advisable to carry out a comparison during 1939-40 in which the carrots would not be fed in excess quantities.

The 1939-40 Trial

Three pens of 75 birds each of White Leghorn pullets of the same ages were used. They were fed laying mashes, as shown in Table 1. Seven per cent of the mash for one pen was dehydrated alfalfa leaf meal; one of the remaining pens was fed cooked carrots and the third pen was fed "Greenmelk", in addition to the laying mash.

Table 1. Laying mashes.

Ingredient	Carrot-fed pen	Greenmelk-fed pen	Alfalfa-fed pen
Ground barley	20	20	20
Wheat bran	20	20	20
Flour middlings	20	20	20
Ground oats	12	12	10
Dehydrated alfalfa leaf meal	—	—	7
Meat scraps	8	8	7
Soybean oil meal	5	5	5
Dried skimmilk	5	5	5
Sardine fish meal	3	3	3
Steamed bonemeal	1	1	1
Oyster shell flour	2	2	1
Iodized salt	1	1	1
Fish oil (400 D)	1	1	1

Whole oats and oyster shell was fed *ad lib.* Gravel was used as grit. A grain mixture of 60 pounds wheat and 40 pounds barley was also fed *ad lib.* in open feeders.

Preparation of Carrots—The carrots used were Chantenay yellow. They were weighed before cooking; generally they were steamed 15 minutes in water by introducing live steam. When steam was not available they were cooked in water just below the boiling point. This treatment softened them sufficiently to increase their palatability and they were readily consumed by the birds. They were fed on top of the dry mash at 11:30 a. m. daily.

"Greenmelk" Preparation—This product was fed at approximately two pounds per 100 birds per day. The "Greenmelk" was diluted, slightly, with water and fed on top of the dry mash at 11:30 a. m. daily.

Results

Feed consumption by the different pens over the six-month period is shown in Table 2. The carrot-fed birds ate approximately the same amount of other feed as the alfalfa-fed pen. The carrots were taken as additional feed.

Table 2. Average feed consumption per bird in pounds.

Month	Carrots					Greenmelk					Alfalfa (dehydrated)			
	Mash	Grain	Oats	Shell	Carrots	Mash	Grain	Oats	Shell	Greenmelk	Mash	Grain	Oats	Shell
November	1.80	3.74	1.03	.31	1.40	2.27	4.40	1.10	.20	.57	1.98	3.74	1.15	.20
December	3.08	3.85	1.37	.23	1.60	2.52	5.10	1.29	.34	.64	2.49	4.32	1.37	.27
January	3.15	4.27	1.50	.42	1.64	2.96	4.87	1.87	.43	.67	2.32	4.34	1.75	.42
February	2.82	4.48	.91	.22	1.63	2.65	4.63	1.52	.24	.66	2.01	4.47	1.17	.27
March	3.34	4.57	1.05	.43	1.60	3.32	4.95	1.55	.48	.69	2.85	4.55	1.65	.51
April	2.75	4.26	1.56	.50	1.54	2.73	4.78	1.29	.49	.68	2.57	4.61	1.36	.49
Total	16.94	25.17	7.42	2.11	9.41	16.45	28.73	8.62	2.18	3.91	14.22	26.03	8.45	2.16

Table 3 shows the number of eggs produced, the percentage egg production on a hen-day basis and the number of birds dying each month. The egg production of the "Greenmelk"-fed pen and the carrot-fed pen was approximately the same with both pens producing more eggs than those receiving alfalfa. Each bird in the alfalfa-fed pen received about 1 pound of alfalfa during the period, compared with 9.41 pounds of carrots and 3.91 pounds of "Greenmelk". On a dry basis the amount of carrots or "Greenmelk" consumed was about equal to that of alfalfa. The cost of feeding the "Greenmelk" was higher than either the carrots or the alfalfa.

Table 3. Egg production hen-day and mortality.

Month	Carrot-fed			Greenmelk-fed			Alfalfa-fed		
	Number eggs	Per cent production	Number died	Number eggs	Per cent production	Number died	Number eggs	Per cent production	Number died
November	1091	48.5	1	1099	49.7	2	992	44.2	1
December	1279	56.6	2	1396	62.0	1	1126	49.7	1
January	1398	63.6	3	1335	61.8	4	1293	58.3	5
February	1148	59.4	2	1140	59.8	6	1119	57.8	3
March	1157	63.8	0	1119	63.7	2	1155	62.8	1
April	990	58.7	4	1017	61.7	2	1071	60.7	4
Total	7063	58.3	12	7106	59.6	17	6756	56.6	15

The mortality was nearly the same for all pens, with the fewest losses occurring in the pen being fed carrots. On a percentage basis,

the losses were 16 per cent, 22.5 per cent, and 20 per cent on the carrots, "Greenmelk", and alfalfa, respectively.

The trial ended April 30 owing to difficulty in keeping the carrots in good condition for a longer time.

It should be noted that yellow corn was not used in these rations.

Vitamin A Storage of Livers and Vitamin A Content of Eggs— The vitamin A content of the eggs was determined at monthly intervals by the Chemistry Department under the supervision of Dr. C. A. Hoppert. The results are given in Table 4. They are stated in Blue units per gram. One Blue unit is approximately equal to one and one-half U. S. P. units of vitamin A. The carrot-fed pen and "Greenmelk"-fed pen produced eggs which maintained the vitamin A level or increased it slightly, whereas those receiving alfalfa produced eggs with a lower amount of vitamin A at the end of the trial. These results are the average of several eggs.

Table 4. Vitamin content of eggs-averages of 6 eggs (Blue units per gram).

Month received	Carrot-fed	Greenmelk-fed	Alfalfa-fed
January	16.6	15.0	12.6
February	16.8	16.0	15.4
March	14.3	13.4	14.0
April	19.7	16.2	15.5
May	20.6	18.2	11.6

The average liver storage of vitamin A was 1520 Blue units per gram for the carrot-fed pen, 626 Blue units for the "Greenmelk"-fed pen and 531 Blue units for those receiving alfalfa. These results were obtained from a composite sample from the livers of four birds from each pen.

Summary

Chantenay yellow carrots may be used as a source of carotene (vitamin A precursor). Presumably any other variety of yellow carrots would give similar results.

The carrots should be cooked without boiling or steamed by use of steam in water to maintain the carotene content.

Eggs from the pen receiving the amount of carrots fed in this trial contained more vitamin A than those receiving "Greenmelk" or alfalfa leaf meal (dehydrated) in the amounts that usually are fed.

When yellow carrots are available and alfalfa products of good quality are not available the carrots may be used as a source of green feed. It should be remembered, however, that good quality alfalfa contains other essential ingredients in the poultry ration.

ROOT AND BUTT ROT IN THE PINETUM AT MICHIGAN STATE COLLEGE

FORREST C. STRONG
Section of Botany

On Nov. 11, 1940, a severe windstorm caused considerable blowing down of trees throughout portions of the upper and lower peninsulas of Michigan. Twelve white pine trees in the pinetum at East Lansing set out by Dr. W. J. Beal in 1896 were partially or completely blown down. According to Chittenden (2) this 44-year-old white pine plantation, the oldest in the state, covers an area of about 3½ acres and is located on sandy and gravelly soil.

The startling feature of this particular blow-down of trees in the pinetum was the revelation of the extent and spread of injury caused by the velvet-topped fungus, **Polyporus schweinitzii,** which attacks the roots and basal portions of coniferous trees, producing a brown charcoal-like decay or rot of the heartwood.

The presence of this root-rotting fungus in the pinetum was first discovered in 1928 by Dr. D. V. Baxter (1) who has found it to be causing considerable damage in white pine plantations located on unfavorable sites or on sites

Fig. 1. Showing extent of decay by *Polyporus schweinitzii* up into trunk of Number 2 tree (see map.) Breaking and splintering extended from three to eight feet above the ground level.

which have become unfavorable through change of the water table or other environmental factors, since such plantations have been started.

Of the trees affected, four broke off from 6 inches to 3 feet above the ground level (Fig. 1). The breaking resulted from the weakening of the trunk structure by the advanced stages of decay which extended from the roots up into the heartwood of the trunks of these trees. In one case the heartwood was severely decayed to a height of more than 10 feet from the ground level. The trees which broke off were of the same diameter as those which remained standing. The average diameter, breast high, of trees in this plantation is from 10 to 12 inches. Five trees blew down by the breaking off of some roots and the uprooting of the main root system (Fig. 2). In such cases several of the main roots had been rotted and weakened by the action of the fungus, thus reducing the anchorage strength of the root system sufficiently so that the trees could not withstand the wind pressure of the storm.

One tree was blown down on the extreme western edge of the stand. It has been found that some of the roots of this tree were also rotted by this pathogen. In the northern portion of the stand two trees were tipped slightly with loosening and cracking of the soil 3 to 4 feet from and around their bases, indicating that roots were possibly broken. Since both trees are located in an area where the root rot fungus is known to be present, it is possible that they are also infected.

Since the date of its discovery, this fungus and its spread have been observed each year by the appearance of the typical dark ochre-colored, velvet-topped sporophores or fruiting bodies (Fig. 3). The fruiting bodies develop in the duff of the forest floor, usually near to trunks of affected trees. Prior

Fig. 2. Example of uprooted tree. Roots decayed extensively but rot has not yet progressed into trunk.

Fig. 3. Fruiting body or sporophore of *Polyporus schweinitzii*, partly obscured by a weed.

to the recent windstorm, only one tree has been known to have blown down as the result of attack by this fungus. However some stumps left from the thinning of 1925 show evidence of decay by this fungus. Inasmuch as Chittenden states that the trees cut at that time were virtually all sound, one must conclude that this decay has developed subsequently.

The number of trees blown down brings sharp attention to the devastating effects of this root and butt rot disease. The rapidity of its spread and injury in the 12-year period since the discovery of the disease leads to speculation concerning the time when all of the pines in this stand will be attacked and succumb.

Mapping of the area (Fig. 4) where the majority of trees were felled by the wind shows very clearly that this fungus has spread from an affected tree to adjacent trees rather than appearing sporadically here and there in the plantation. The tree blown down in 1930 showed many roots rotted, and decay had extended several feet up into the trunk. This tree was located approximately in the center of the area of most severe damage, and the four trees most extensively rotted were nearest to the location of the tree first affected.

It is possible that the stumps of the thinning in 1925 may have served as receptors of spores for the entry of the root rot fungus into this stand. It is recalled that collections of fruiting bodies of the fungus have been made from a Norway spruce stump located on the college campus, from a larch stump in the northern edge of East Lansing, and from a white pine stump located on the college farm. The proximity of these root rot fungus foci indicate the possible presence of others, some of which could conceivably have furnished

spore material to start development in pinetum trees. Once established in the roots of a dead or living tree, this pathogen can make progress from tree to tree by contact or fusion of roots resulting from the close placement of the pine trees. Infection of living trees may have occurred by the germination of the spores of the fungus in the duff on the forest floor and eventual contact of the mycelium with roots. The exact manner in which the infection under consideration occurred is not known.

York (4) indicates from studies of white pine plantations in New York that planted trees develop more soil pockets under the root crown owing to the manner of planting of the trees. Hurried plantings of trees brings about a crossing and often twisting of the roots which later, when these roots have grown larger, bring about fusion of roots with each other and the production of these pockets. The bark surrounding such pockets is thin and the soil inclosed may have root-rotting fungi present which can easily penetrate the wood.

From the information at hand, it would seem that greater care should be exercised in selection of favorable sites for the planting of white pine to avoid stagnation of growth of the trees when they reach an age of 20 or more years. Stagnation of growth and reduction of annual increment may be and probably is favorable for the growth of the root decay fungus. Thinning of the stand under consideration to encourage undiminished growth has been urged by the foresters of this institution but has been met with strong adverse public sentiment for this particular stand. Greater care in planting the trees may in the long run be advisable to avoid production of soil-filled pockets through which root infections can occur.

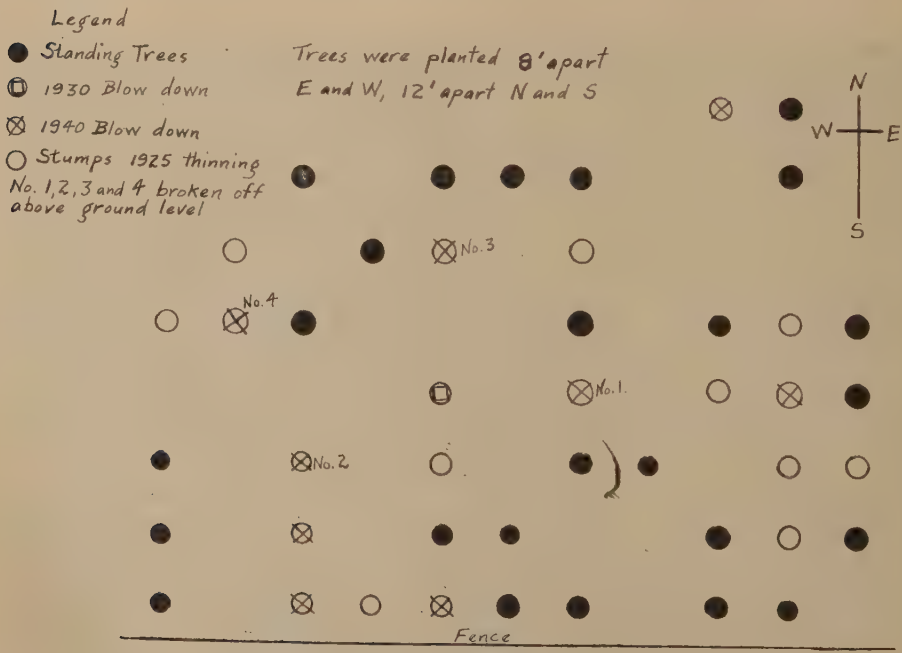

Fig. 4. Map of principal blowdown area, showing spread of *Polyporus schweinitzii* infection.

Fig. 5. Illustrating partial breaking off at ground level and uprooting.

The question has arisen whether this disease in this or other white pine stands can be eradicated after once becoming so well established. From a silvicultural standpoint the improvement of vigor of the stand by thinning or fertilization would discourage the spread of the pathogen to still healthy trees. From the standpoint of actual eradication of the diseased trees and eradication of the fungus, it seems very certain that no economically feasible method is known. From a recreational and esthetic viewpoint it may be advisable to attempt control by actual removal of all affected trees, and sterilization of the soil with carbon disulphide in the manner worked out by Hewitt (3) in California where Armillaria root rot has become established in citrus groves.

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(3) Hewitt, H. Lee, 1936. Control of Armillaria root rot with carbon disulphide. Bulletin of Calif. Dept. of Agriculture *25* (2) : 226-234.

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A CONVEYOR FOR HANDLING POTATOES

TIME IS SAVED—QUALITY IMPROVED

E. J. WHEELER, FLOYD LINEBAUGH AND C. H. JEFFERSON
SECTIONS OF FARM CROPS AND AGRICULTURAL ENGINEERING

Michigan potato growers harvest annually from 20–25 million bushels of potatoes, perhaps one-half of which are stored either on the farm or in central warehouses. Each year from 10–15 per cent of these potatoes are lost, owing to improper methods of handling and storing. A loss of from 3–4 per cent may be expected from natural loss of moisture, but greater losses are often the result of bruises or major mechanical injuries received in handling. This increases the evaporation of moisture and causes excess rotting, a large part of which can be avoided.

One method of handling potatoes to save time and reduce mechanical injury is the use of a belt conveyor similar to the one shown in Fig. 1. This conveyor will handle up to 500 bushels of bulk potatoes per hour from truck or wagon into storage bin at a total cost of about two cents for electricity.

The loss, in storage, of potatoes handled by this conveyor as compared to losses from other methods is shown in Table 1.

Fig. 1. A conveyor for handling potatoes or other farm produce, similar to the one illustrated here, may be constructed for approximately $100.

Table 1. Comparison of potato losses with methods of handling.

Method of Handling	Shrinkage	No. 1
	per cent	per cent
With elevator	6.5	82
*Dump from sacks into bin	6.6	80
Picked and stored in boxes	4.3	90
Estimated average shrinkage for state	8–10	75

*When potatoes are piled too high to dump directly from sacks (or crates) padded planks are laid over bin to reduce injury when walking over potatoes.

Although the shrinkage loss in potatoes handled with an elevator is only slightly less than in potatoes carefully handled by other methods, considerable time is saved by using the elevator. In one instance, four men handling crates were required to handle the same volume of potatoes that two men could handle with the elevator. It seems reasonable to conclude that the labor of at least one man might be saved by using an elevator.

Another distinct advantage of the elevator is the amount of dirt which is removed by the slatted bottom hopper. Approximately 1½ pounds of dirt per bushel were removed in handling one lot of 65 bushels of potatoes. Dirt ordinarily carried in with potatoes is a constant source of trouble; it fills the space between potatoes, interfering with circulation of air and also accumulates moisture and provides an ideal place for the growth of fungi. This is particularly objectionable in wet years, such as this, 1940, when late blight is prevalent.

The potato elevator itself is composed of a belt conveyor, a hopper, and a carriage which regulates the height of the belt and makes the unit portable. The belt is one of the most important items and if purchased new may represent the major item of expense. The elevator shown here uses a part of a rubber belt salvaged from a large industrial plant where such belts are frequently discarded. It is a 16-inch, 3-ply (one rubber and two canvas) vulcanized belt 28 feet long. The expense of a new belt of similar type would hardly be justified. For a new belt it is suggested that a 2-ply 16-inch canvas belt be obtained at a cost of approximately 50¢ a lineal foot.

The maximum length of conveyor seems to be about 16 feet if it is to be driven from a motor mounted on the lower end, as the one illustrated here. The belt is tightened by an adjustable 4-inch roller at the top end and travels at the rate of about 120 feet per minute, using a 4-inch roller at the bottom. The 4-inch steel roller is wrapped with rubber belting to provide additional friction which is desirable to prevent the conveyor belt from slipping.

To overcome any tendency of the potatoes to roll backwards on the conveyor, particularly at steep angles, 15-inch lengths of one-inch garden hose are attached to the belt from 12 inches to 15 inches apart.

The sides of the conveyor are made of 2-inch by 6-inch material bolted together with bolts placed inside of one-inch pipe spaces. Large washers are used at each end of the pipe to provide greater bearing surface. The bed of the conveyor supporting the belt is made of two 1-inch by 8-inch boards sloping toward the middle and resting on the pipe spaces. It may be desirable when elevating at steep angles to at-

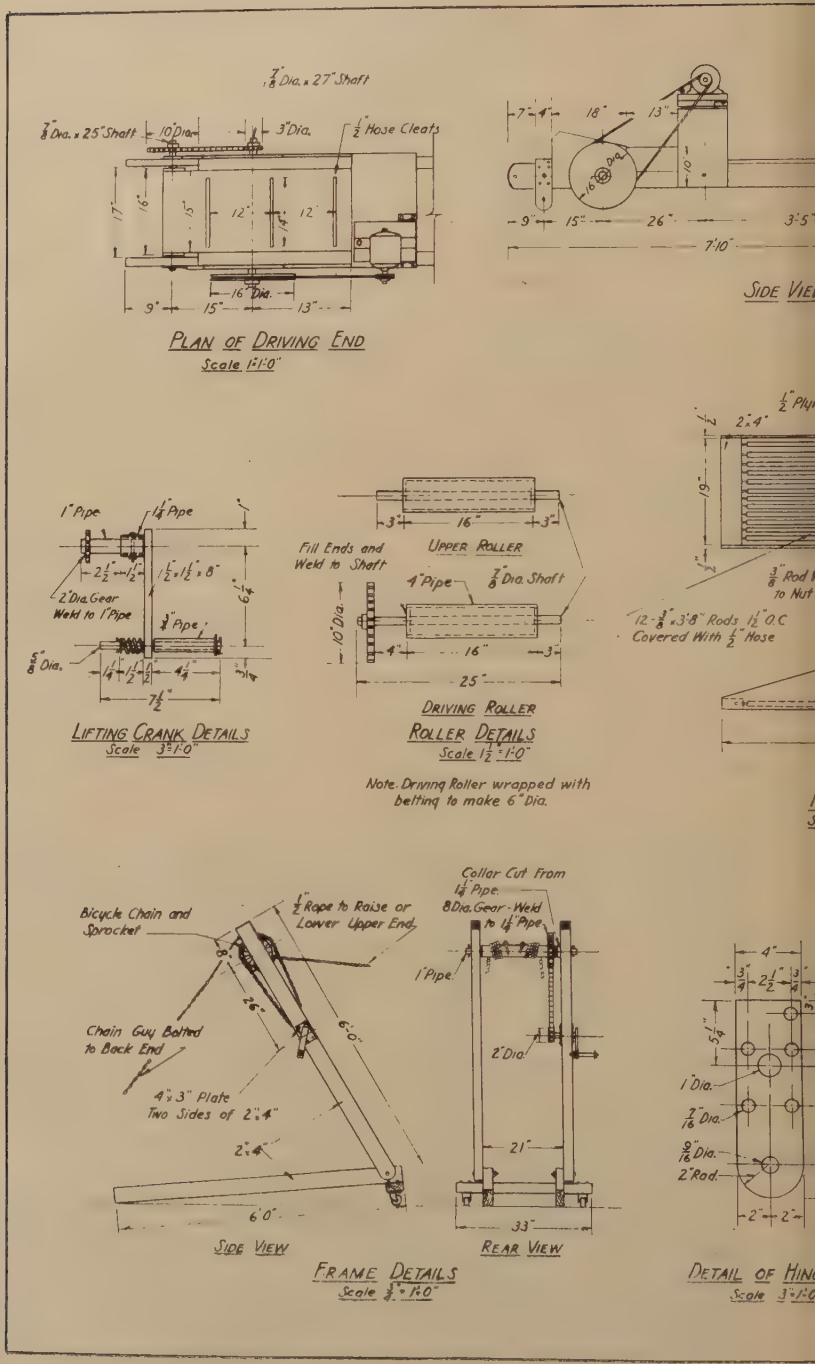
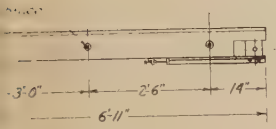
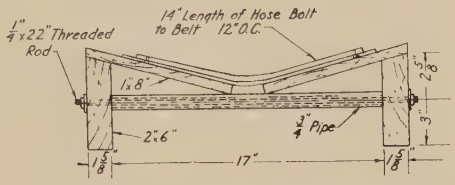
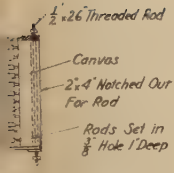

7/8" Dia. x 27" Shaft
7/8" Dia. x 25" Shaft
10" Dia.
3" Dia.
1/2" Hose Cleats
17"
16"
15"
12"
12"
16" Dia.
9"
15"
13"
PLAN OF DRIVING END
Scale 1"=1'-0"
7"
4"
18"
13"
10"
16" Dia.
9"
15"
26"
7'-10"
SIDE VIEW
1" Pipe
1/4" Pipe
2 1/2"
1 1/2"
1 1/2" x 1 1/2" x 8"
6 1/4"
2" Dia. Gear Weld to 1" Pipe
1/4" Pipe
5" Dia.
1/4"
1 1/2"
1 1/2"
4 1/4"
3/4"
7 1/2"
LIFTING CRANK DETAILS
Scale 3"=1'-0"
3"
16"
3"
Fill Ends and Weld to Shaft
UPPER ROLLER
4" Pipe
7/8" Dia. Shaft
10" Dia.
4"
16"
3"
25"
DRIVING ROLLER
ROLLER DETAILS
Scale 1 1/2"=1'-0"
Note. Driving Roller wrapped with belting to make 6" Dia.
1/2" Ply
2"x4"
19"
3/8" Rod to Nut
12-3/8" x 3'-8" Rods 1/2" O.C
Covered With 1/2" Hose
Bicycle Chain and Sprocket
1/2" Rope to Raise or Lower Upper End
Collar Cut From 1 1/4" Pipe. 8" Dia. Gear - Weld to 1 1/4" Pipe
1" Pipe
Chain Guy Bolted to Back End
4"x3" Plate Two Sides of 2"x4"
2"x4"
6'-0"
26"
6'-0"
2" Dia.
21"
33"
SIDE VIEW
REAR VIEW
FRAME DETAILS
Scale 3/4"=1'-0"
4"
3/4"
2 1/2"
3/4"
5 1/4"
1" Dia.
7/16" Dia.
9/16" Dia.
2" Rad.
2"
2"
DETAIL OF HINGE
Scale 3"=1'-0"

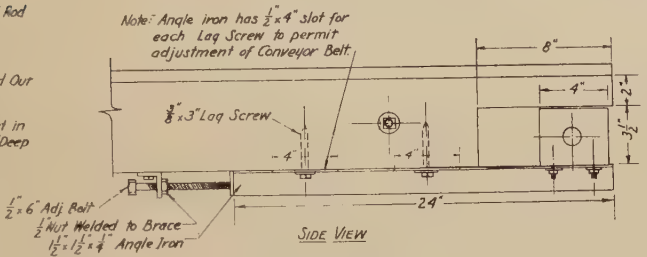
Fig. 2. D



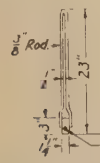


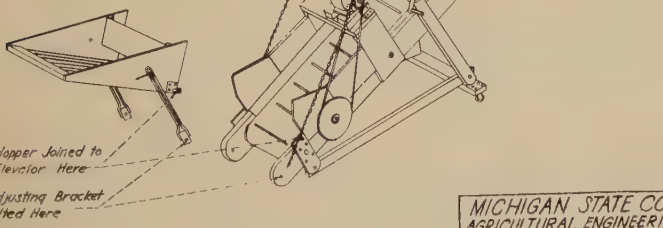
CROSS SECTION OF CONVEYOR
Scale 3"=1'-0"





SIDE VIEW

DETAIL OF UPPER END
Scale 3"=1'-0"

HOPPER ADJ. BRACKET
Scale 1"=1'-0" Two Required



ASSEMBLED ELEVATOR

MICHIGAN STATE COLLEGE AGRICULTURAL ENGINEERING DEPT. EAST LANSING, MICH.		
POTATO ELEVATOR		
PLANNED C.H.J	APP BY A.R.Th	11-4-40
DRAWN R.G.H.	DATE 11-1-40	SHEET 1 OF 1
TRACED R.G.H.	SCALE NOTED	NO. 31709-14.
CHECKED H.J.O.		

tato elevator.

tach 4-inch sideboards approximately 8 feet long at the lower end of the elevator to prevent potatoes from rolling from the conveyor.

The sides of the conveyor are hinged in the center so that the upper half may be folded back over the lower half for convenience in loading onto a truck for transportation and to reduce space required for storage.

The conveyor is attached at the lower end to the carriage and pivots from this point. It moves freely through the upright and is raised or lowered by a winch. The carriage is mounted on heavy casters for convenience in moving it from bin to bin or for moving from one side of a bin to the other as the bin is being filled. This carriage permits the belt to be raised about 9 feet from the floor, which is adequate for most Michigan storages.

The carriage might be eliminated for some purposes and the construction thereby simplified. In that case, the upper end of the conveyor would be supported in some other manner, depending upon where the conveyor is to be used. For use on the inside of a storage house the upper end could be supported from a wire or track suspended from the ceiling.

A removable hopper is attached to the lower end of the conveyor into which bulk potatoes are dumped from wagon or truck. The hopper has a slatted bottom made by placing rubber-covered ⅜-inch iron rods about ½-inch apart, to prevent injury to the potatoes as they are being handled. Old garden hose may also be used for this purpose.

This hopper may be removed for handling sacked potatoes from a storage house into trucks or directly into freight cars for shipment. Approximately 150 one hundred-pound sacks may be loaded per hour. The elevator shown is equipped with a ½-horsepower motor, but for handling sacked potatoes a ¾-horsepower motor is more desirable.

In addition to saving labor and reducing injury in handling potatoes this elevator may be used for ear corn, small grain, or other similar purposes on many farms in Michigan.

PRUNING MATURE KIEFFER PEAR TREES

STANLEY JOHNSTON
Section of Horticulture

Until recent years, the Kieffer pear was considered a liability on many fruit farms rather than an asset. Then commercial canners learned how to prepare a very good canned product from this variety and the demand for it since has been sufficient to use all supplies at reasonably good prices.

The Kieffer pear has a tendency to set very heavily in certain years and has acquired a biennial bearing habit to some extent on this account. In years of heavy production, a high percentage of the pears is likely to be rather small. This has been a disadvantage because canneries desire pears of medium size and offer a much lower price for those of the 1¾ to 2-inch size, sometimes refusing to take them. Growers have doubted the economic value of thinning the fruits of this variety after setting and have depended largely upon pruning to regulate the size of the fruits.

Two widely divergent types of pruning have been used on Kieffer pear trees in Michigan. In some orchards a severe heading-back type of pruning has been used. Other trees have been pruned according to a light thinning-out method in which closely crowded branches and old, weak spurs were removed.

To determine the best method of pruning Kieffer pear trees in full bearing, an experiment was started in the James Hosking orchard near South Haven in 1933. The trees used were 35 years old at the beginning of the experiment

Fig. 1. Three different types of growth found in mature Kieffer pear trees as the result of different pruning methods:

(Left) Type of growth found in trees receiving the thinning method of pruning or no pruning. No moderately vigorous new fruiting wood has been formed. Trees making this kind of growth will produce a high percentage of small pears and will be inclined to bear alternately heavy and light crops.

(Center) Type of growth produced in trees receiving a moderate heading pruning. Note the moderately vigorous new wood with an abundance of strong new fruit spurs.

(Right) Type of growth produced in trees receiving a severe heading back each year. As a result of this method of pruning very vigorous new shoot growth is produced with few fruit spurs being formed. Small yields of very large pears are produced.

and in excellent condition. They had received a moderate type of pruning regularly and had been well fertilized, sprayed and cultivated. Trees for the different pruning treatments were carefully selected so as to have the average tree size in each plot as nearly alike as possible.

The following pruning treatments were used:

Thinning—Branches were thinned where crowding and some very old weak spurs were removed. Because the Kieffer tree is naturally a very open-growing type, the pruning given under this method would be considered light.

Moderate Heading—All branches making less than approximately 6 inches of new terminal growth were headed back into wood two and three years old.

Severe Heading—In the spring of 1938 it was decided that the heading-back that had been used was not severe enough to compare with that used in some Kieffer orchards in the state where all of the new shoots are cut back to 3 or 4 inches in length each year. This type of pruning has sometimes been called "hedge-row pruning". Accordingly, this method of pruning was included and compared with the moderate-heading type in 1939 and 1940.

Unpruned—Unpruned trees were left for checks during the first five years of the experiment, 1933 to 1937, inclusive. Owing to the excellent care the orchard had received previously, the unpruned trees did not show the ill effects of no pruning until the experiment was under way for about three years.

The results of the experiment are presented statistically in Table 1. The pears were graded as harvested and yields in pounds recorded for the various grades. Values were calculated on the basis of prevailing prices paid by the canning factory during the course of the experiment. These were 90 cents per hundredweight for all pears 2¼ inches and over in diameter; 60 cents for the same quantity from 2 to 2¼ inches in diameter; and 30 cents per hundredweight for pears from 1¾ to 2 inches in diameter. For better understanding, the actual yields and values for the plots of 12 trees are also presented on an acreage basis.

At first glance (Table 1, part 1) one might question the value of pruning during the first three years of the experiment (1933-35, inclusive). On an acreage basis, moderate heading showed a gain of only $10.17 per acre over no pruning, while the thinning type of pruning showed a loss of $18.54 compared with the trees receiving no pruning. A question might arise as to why the thinning method did not make so good a showing as no pruning. The most plausible explanation seems to be that the thinning of certain branches reduced total production without causing any marked increase in the size of the fruits produced. This is exactly opposite to what took place in the trees receiving the heading-back type of pruning where total yields were reduced but a marked increase in size of the remaining fruits resulted in a greater total value. About 133 bushels (7,308 pounds) less pears were harvested from the trees receiving a moderate heading type of pruning than those which received no pruning to return $10.17 greater dividends. This would mean a considerable saving in harvesting and handling charges in favor of the moderately headed trees.

Table 1, part 2 shows the ill effects of continued lack of pruning mature Kieffer pear trees, or persistence in using the thinning type of pruning which

do not result in the development of moderately vigorous new producing wood. It will be noticed that the return on an acreage basis from the moderately headed trees was $62.82 greater per year than from trees receiving no pruning and $74.16 greater than from trees pruned by the thinning method. The generally lower trend in yields compared with the previous three years (1933-35, inclusive) can be accounted for by a very severe drouth in 1936 which not only reduced the crop that year but also noticeably reduced the 1937 crop.

In 1938 it was decided that the moderate type of heading used was not severe enough to be compared with the "hedge-row" type of pruning used in some Kieffer pear orchards. Accordingly, a new plot was established in the spring of 1938 in which the trees were headed back into wood from two to four years of age. Following this treatment, all new shoots were cut back to about 4 inches in length in the spring of 1939 and again in 1940. Table 1, part 3 shows the results of this type of severe heading as compared to trees receiving the moderate heading type of pruning. The severe heading reduced the value per acre $65.43, or about 32 per cent.

Observations were made with regard to the amount of time required to prune trees according to the different methods. Severe heading required the

Table 1. Yields and grades of Kieffer pears produced on trees receiving different pruning treatments together with values calculated on the basis of canning factory grades and prices.

(Twelve trees in each treatment)

PART 1. AVERAGE YIELDS PER YEAR FOR THE YEARS 1933-35, INCLUSIVE.

Pruning Treatment	A-Grade 2¼ Inches and Over		B-Grade 2 to 2¼ Inches		C-Grade 1¾ to 2 Inches		Totals—Twelve Trees		Totals on Acreage Basis	
	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value	Pounds	Value
Thinning	1,151	$10.36	1,907	$11.44	1,242	$ 3.73	4,300	$25.53	38,700	$229.77
Moderate Heading	1,930	17.37	1,526	9.16	729	2.19	4,185	28.72	37,665	258.48
Unpruned	954	8.59	2,292	13.75	1,751	5.25	4,997	27.59	44,973	248.31

PART 2. AVERAGE YIELDS PER YEAR FOR 1936 AND 1937.

Thinning	760	$ 6.84	1,014	$ 6.08	1,371	$ 4.11	3,145	$17.03	28,305	$153.27
Moderate Heading	1,429	12.86	1,636	9.82	864	2.59	3,929	25.27	35,361	227.43
Unpruned	720	6.48	1,195	7.17	1,547	4.64	3,462	18.29	31,158	164.61

PART 3. AVERAGE YIELDS PER YEAR FOR 1939 AND 1940.

Moderate Heading	925	$ 8.33	1,849	$11.09	1,087	$ 3.26	3,861	$22.68	34,749	$204.12
Severe Heading	893	8.04	1,035	6.21	386	1.16	2,314	15.41	20,826	138.69

NOTE:—The prevailing prices for different grades paid by the canning factory during the course of this experiment were: A-grade, 90 cents per hundredweight; B-grade, 60 cents; C-grade, 30 cents.

most time, in addition to reducing the total yield more than any other treatment. Moderate heading required slightly more time than the thinning method. However, this expense in time was more than offset in the increased total value of the crop produced, and the saving in harvesting and handling expenses. The larger pears produced on the moderately headed trees were harvested with less expense and fewer small pears were picked, hauled to the canning factory, and then hauled home again as rejects because of small size.

The results of this experiment indicate that from the standpoint of increased income and as an aid to annual bearing, the moderate heading method seems best suited to Kieffer pear trees in full bearing. It is suggested that this type of pruning be withheld until the trees are in full bearing and beginning to lose some of their early vigor. To use this method on young trees would reduce their size and might result in such a succulent growth as to make them more susceptible to blight. Young pear trees grown under proper conditions will usually be vigorous enough during the first few years to produce fruits of good size without pruning. The danger of rendering Kieffer trees in full bearing more susceptible to blight in the commercial pear-growing districts of Michigan by using the moderate heading method of pruning is not considered to be serious. Care should be used, however, to prevent excessive new growth in pear trees, even those in full bearing. It would be safer to regulate pruning and cultural practices so that new terminal growth in general will not exceed 12 to 14 inches in length in bearing trees.

The best indicator for the grower to use as to the need for pruning mature Kieffer pear trees is the amount of terminal growth that is being made each year. If at least approximately 6 inches of new terminal growth cannot be maintained by cultivation or a satisfactory mulch system plus the use of fertilizer, it is then necessary to resort to the moderate heading type of pruning. In using this method of pruning it should be remembered that not all branches are headed back each year. Only those whose terminal growths are falling below approximately 6 inches should be cut back into wood two or three years old. In addition, it is considered advisable to thin the oldest and weakest spurs. These are not common until the tree becomes rather old and then are usually found in the center of the tree. This method of pruning results in a gradual renewal of moderately vigorous new wood which will maintain maximum yields of pears of first-grade size, provided the trees are otherwise given good care.

THE NUTRITIVE VALUE OF CHICORY TOPS FOR DAIRY CATTLE*

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SECTIONS OF DAIRY HUSBANDRY AND CHEMISTRY

Chicory and chicory tops have not been used extensively as a feed for livestock. Aguirre (1), however, suggested that they could be used as a cattle feed and presented data on the chemical composition of chicory. Donegan

*The authors are indebted to McMorran and Company, Port Huron, Mich., for supplying them with dried chicory tops.

(2) reported that chicory roots made an excellent substitute for oats in the ration of horses. No bad effects were observed from the feeding of chicory and it was thought that it may have exerted a favorable influence on digestion. Up to 10 pounds of chicory per day per horse were consumed readily. The moisture, protein, fat, nitrogen-free extract, and sugar were found to be 13.8, 4.8, 0.85, 69.7, and 4.35 per cent, respectively. The chicory roots contained 87 feed units in comparison with 82 feed units in dried sugar beets. Rather (3) stated that chicory tops are less valuable as a feed for livestock than sugar beet tops and that, to avoid the danger of producing off-flavored milk, milking cows should not be fed chicory tops.

Because Michigan has almost a monopoly in the production of chicory in the United States and because of the paucity of data concerning the feeding value of chicory tops, feeding experiments were conducted with dairy cattle to ascertain the palatability, physiological effects upon the animal, and the coefficients of digestibility of the tops.

Results

The chicory tops used in this investigation were dehydrated. The leaves were well-cured but many of the crowns and stalks were moldy. The composition of the chicory tops is given in Table 1.

Table 1. Chemical Composition of Chicory Tops.

	As fed	Dry basis
	(per cent)	(per cent)
Moisture	17.4	—
Ash	14.9	18.0
Protein	11.8	14.4
Ether extract	1.85	2.24
Nitrogen-free extract	41.5	50.3
Crude fiber	12.6	15.3
Calcium	1.56	1.89
Phosphorus	0.18	0.22
Magnesium	0.60	0.73
Oxalic acid	0.54	0.65

The calcium-phosphorus ratio in the chicory tops was found to be 8.6 to 1.

Metabolism trials were conducted with three dry cows to determine the coefficients of digestibility of the dried tops. Calcium, phosphorus, magnesium and nitrogen balances were also determined on the same cows. The results obtained by these trials are presented in Table 2.

The appetite for dried chicory tops was measured by determining the

Table 2. Digestion Coefficients and Metabolism Data Obtained from Chicory Tops.

Cow No.	Coefficients of Digestibility						Balances (average daily)			
	Dry matter	Crude protein	Ether extract	Crude fiber	Organic matter	N.F.E.	Ca	P	Mg	N
	per cent	per cent	per cent	per cent	per cent	per cent	gms.	gms.	gms.	gms.
A-4	63.3	53.8	5.8	59.4	67.6	76.9	−10.8	3.7	7.5	− 8.6
D-5	61.9	56.3	2.9	51.5	67.0	77.7	− 0.6	1.7	2.3	−10.3
D-9	65.1	55.3	18.7	61.9	69.3	77.8	− 3.3	1.9	12.3	4.3
Average	63.4	55.1	9.1	57.6	68.0	77.5	− 4.9	2.4	7.4	− 4.9

average daily consumption after the cows had become accustomed to eating the tops and then comparing this intake to the average daily consumption of alfalfa hay. The cows consumed about 25 per cent less chicory tops than alfalfa hay; however, one cow ate 30 pounds of tops daily and another cow consumed 35 pounds daily.

The consistency of the feces was determined, and the results indicate that the consumption of chicory tops did not change the consistency significantly from that obtained from cows receiving alfalfa hay. There was a tendency, however, for the feces to be slightly softer.

The effect of chicory tops on milk production was not determined specifically although one cow made an average gain of 4 pounds of 4 per cent fat-corrected milk per day on 9 pounds less of tops than alfalfa hay. This finding needs further confirmation before any definite conclusion can be drawn.

The flavor of the milk was studied by Trout of the Dairy Section who found that the feeding of chicory tops did not alter the flavor of the milk.

Discussion

The chicory tops fed in this investigation were characterized by high ash values, comparable with those of sugar beet tops and immature grasses, but the tops were low in crude fiber in comparison with mature grasses. The chicory tops were high in calcium and magnesium but low in phosphorus.

The high ash and magnesium content of chicory tops might be expected to exert a laxative effect upon the cows but the results of this experiment indicate that the consistency of the feces obtained from chicory tops was not significantly different from feces obtained from cows on an alfalfa ration.

The coefficients of digestibility for dry matter, crude protein, crude fiber, organic matter, and nitrogen-free extract were 63.4, 55.1, 57.6, 68.0, and 77.5 per cent, respectively. The total digestible nutrients content of the chicory tops used in this experiment was 57 pounds per 100 pounds of dry matter. According to Morrison (4) sugar beet tops have 65 pounds of total digestible nutrients per 100 pounds of dry matter. On the dry matter basis, chicory tops are somewhat less valuable than sugar beet tops in the ration of dairy cattle.

Summary

The chemical composition of dried chicory tops has been determined and metabolism trials have been conducted to determine the coefficients of digestibility. The average coefficients for dry matter, crude protein, crude fiber, organic matter, and nitrogen-free extract were found to be 63.4, 55.1, 57.6, 68.0, and 77.5 per cent, respectively. The total digestible nutrients content of the chicory tops was 57 per cent on the dry basis.

The cows consumed about 25 per cent less tops than alfalfa hay. From 30 to 35 pounds of tops were consumed daily per cow.

The feeding of dried chicory tops did not alter the flavor of the milk.

The feeding of dried chicory tops did not have any appreciable effect upon the consistency of the feces.

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HOME-GROWN FARM PRODUCE USED BY THE FARM HOUSEHOLD

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One of the best markets a farmer has for some of the produce raised on the farm is his own household. For home-grown produce used in this way he receives not farm prices but in a sense the equivalent of retail prices. A family, living in the city or even in the country, which has to buy most of these products knows what this means.

A complete record of the amounts and values of home-grown farm products used by the farm household was kept on 268 Michigan farms in 1939. These records were distributed throughout the state and were kept as a part of the regular farm accounting extension project sponsored by the Farm Management Department of Michigan State College and the county agricultural agents in 77 counties. There were 1,496 farm account books summarized in this project but only 268 farmers kept complete records on the home-grown farm produce used by the household, other records being only partial or incomplete.

Farm prices, as estimated by the cooperators in the various parts of the state, instead of retail prices, were used in computing the values of the farm products used by the household. These prices varied greatly between areas and also between farms in the same area. In general the prices averaged about one-half of city retail prices. In addition to the farm produce used by the household the farm family received the use of the house. An annual house rent was figured at 10 per cent of the estimated value of the farm house.

Michigan is large and contains within its boundaries a great variation in conditions. Factors such as soil, climate, topography, markets, transportation facilities, nationality of the people, and many others vary greatly and in turn cause much variation between areas in the amounts and prices of farm products used by the household. Thus, in this report the average figures for the state as a whole are first presented and then for each of three different areas into which the state is divided.

Averages for 268 Michigan Farms

The average value of home-grown farm produce used by the household on the 268 farms in 1939 was $293.08 and ranged from $78 to $761 (see Table 1). The average size of family was 3.3 adults, and 1.6 children under 16 years of age. The house rental charge averaged $193.80 and ranged from $19.50 to $564.00. The combined value of the farm produce and house rental charge amounted to $486.88 per farm.

In addition to the average amounts and value of farm produce used by all families included in the report, it is also interesting to know what these data amount to for just the families that used the particular items (see Table 1). The 268 households used an average of 29 cords of wood valued

Table 1. The amounts and values (at farm prices) of home-grown farm products used by farm households on 268 Michigan farms during 1939. Average size of family 3.3 adults, and 1.6 children under 16 years of age.

Item	Average per farm for the 268 farms			Average for farms using			
				Farms			
	Amount	Price	Value	No.	Per cent	Amount	Value
Fuel, cords	29	$1.59	$ 45.94	228	85	34	$54.00
Milk, quarts	1,315	.034	44.68	265	99	1,330	45.19
Cream, pints	114	.13	14.54	175	65	175	22.27
Butter, pounds	107	.28	30.11	183	68	157	44.10
Eggs, dozen	141	.19	26.22	243	91	155	28.92
Poultry, pounds	*101	*.16	15.72	232	87	*117	18.16
Beef, pounds	109	.12	13.04	115	43	255	30.38
Pork, pounds	275	.09	24.75	196	73	377	33.84
Mutton, pounds	9	.11	.95	26	10	91	9.77
Potatoes, bushel	32	.57	18.43	264	99	33	18.71
Other vegetables	—	—	19.28	†243	91	—	21.26
Fruit	—	—	12.39	206	77	—	16.13
Products canned	—	—	25.08	197	74	—	34.12
Miscellaneous	—	—	1.95	55	21	—	9.49
Average per farm			293.08				
House rent			193.80				

*91 cases estimated.
†Undoubtedly all the farms used some fresh vegetables. On account of the small amounts of the different vegetables consumed at any one time, however, and the trouble involved in recording the values of these products a few farms did not report the use of these items.

at $45.94 per farm. However, there were only 228 households that used wood from the farm, which increased the average to 34 cords of wood valued at $54.00 per farm using. On some items the lack of comparable quantity units has resulted in showing only average values.

Home-grown Farm Products Used in Southern Michigan

This region includes 161 farms located in counties lying south of a line drawn across the state from the southern boundaries of Arenac County on the east to Mason County on the west. Approximately 60 per cent of the farms included in the study are located in this region.

The average value of home-grown farm produce used by the household on these farms was $284.61 and ranged from $78 to $761 (see Table 2). The average size of family was 3.2 adults, and 1.5 children under 16 years of age. The house rental charge averaged $220.17 and ranged from $19.50 to $564. The combined value of the farm produce and house rental charge amounted to $504.78 per farm. Table 2 also shows the average amounts and values of farm produce per family using the particular items.

Northern Michigan (Lower Peninsula)

This region includes 69 farms located in the Lower Peninsula counties lying north of a line drawn across the state from the southern boundaries of Arenac County on the east to Mason County on the west. Approximately 26 per cent of the farms included in the study are located in this region.

The average value of home-grown farm produce used by the household on these farms was $305.36 and ranged from $79 to $729 (see Table 3). The average size of family was 3.2 adults, and 2 children under 16 years of

Table 2. The amounts and values (at farm prices) of home-grown farm products used by farm households on 161 southern Michigan farms during 1939. Average size of family 3.2 adults, and 1.5 children under 16 years of age.

Item	Average per farm for the 161 farms			Average for farms using			
				Farms			
	Amount	Price	Value	No.	Per cent	Amount	Value
Fuel, cords	27	$1.54	$ 41.55	140	87	31	$47.79
Milk, quarts	1,268	.037	47.26	158	98	1,292	48.16
Cream, pints	83	.13	10.99	92	57	146	19.24
Butter, pounds	87	.29	24.91	96	60	146	41.78
Eggs, dozen	159	.18	28.91	149	93	171	31.23
Poultry, pounds	*113	*.15	17.09	142	88	*128	19.38
Beef, pounds	113	.13	14.18	70	43	260	32.60
Pork, pounds	254	.09	21.77	116	72	353	30.22
Mutton, pounds	9	.11	.92	14	9	98	10.57
Potatoes, bushel	31	.59	18.15	159	99	31	18.38
Other vegetables	—	—	20.42	†145	90	—	22.68
Fruit	—	—	12.73	122	76	—	16.80
Products canned	—	—	23.71	111	69	—	34.39
Miscellaneous	—	—	2.02	39	24	—	8.33
Average per farm			284.61				
House rent			220.17				

*58 cases estimated.
†See footnote on Table 1.

age. The house rental charge averaged $159.36, and ranged from $22.50 to $500. The combined value of the farm produce and house rental charge amounted to $464.72. Table 3 also shows the average amounts and values of farm produce per family using the particular items.

Table 3. The amounts and values (at farm prices) of home-grown farm products used by farm households on 69 northern Lower Peninsula Michigan farms during 1939. Average size of family 3.2 adults, and 2.0 children under 16 years of age.

Item	Average per farm for the 69 farms			Average for farms using			
				Farms			
	Amount	Price	Value	No.	Per cent	Amount	Value
Fuel, cords	32	$1.55	$ 49.29	51	74	43	$66.69
Milk, quarts	1,132	.030	34.39	69	100	1,132	34.39
Cream, pints	171	.13	21.86	57	83	206	26.46
Butter, pounds	145	.28	40.30	59	86	170	47.14
Eggs, dozen	122	.18	21.98	61	88	138	24.87
Poultry, pounds	*92	*.16	14.80	61	88	*104	16.74
Beef, pounds	106	.11	11.54	27	39	271	29.48
Pork, pounds	342	.09	30.30	56	81	421	37.34
Mutton, pounds	13	.11	1.41	10	14	91	9.70
Potatoes, bushel	34	.48	16.33	67	97	35	16.82
Other vegetables	—	—	19.56	†65	94	—	20.77
Fruit	—	—	12.83	55	80	—	16.09
Products canned	—	—	29.00	55	80	—	36.38
Miscellaneous	—	—	1.77	11	16	—	11.09
Average per farm			305.36				
House rent			159.36				

*24 cases estimated.
†See footnote in Table 1.

Table 4. The amounts and values (at farm prices) of home-grown farm products used by farm households on 38 Upper Peninsula Michigan farms during 1939. Average size of family 3.6 adults, and 1.5 children under 16 years of age.

Item	Average per farm for the 38 farms			Average for farms using			
				Farms			
	Amount	Price	Value	No.	Per cent	Amount	Value
Fuel, cords	32	$1.85	$58.42	37	97	33	$60.00
Milk, quarts	1,846	.028	52.47	38	100	1,846	52.47
Cream, pints	145	.11	16.29	26	68	211	23.81
Butter, pounds	124	.27	33.63	28	74	168	45.64
Eggs, dozen	101	.22	22.53	33	87	116	25.94
Poultry, pounds	*69	*.17	11.55	29	76	*90	15.14
Beef, pounds	99	.11	10.95	18	47	210	23.11
Pork, pounds	244	.11	27.26	24	63	387	43.17
Mutton, pounds	2	.11	.24	2	5	42	4.50
Potatoes, bushel	35	.68	23.45	38	100	35	23.45
Other vegetables	—	—	13.90	†33	87	—	16.00
Fruit	—	—	10.18	29	76	—	13.34
Products canned	—	—	23.79	31	82	—	29.16
Miscellaneous	—	—	1.97	5	13	—	15.00
Average per farm			306.63				
House rent			144.72				

*9 cases estimated.
†See footnote in Table 1.

Upper Peninsula

This region includes 38 farms located in the Upper Peninsula. This is rather a small number and represents only 14 per cent of the total number

Table. 5. The average amounts of farm products used annually by farm households on some account keeping farms in Michigan, for six individual years, and the six-year average.*

Item	1929	1931	1933	1935	1937	1939	6-year** average
Number of records	51	284	278	163	255	268	216
Fuel, cords	20	25	27	28	24	29	26
Milk, quarts	1,204	1,241	1,199	1,263	1,239	1,315	1,244
Cream, pints	114	87	113	88	105	114	104
Butter, pounds	123	103	99	99	93	107	104
Eggs, dozen	137	137	131	116	124	141	131
Poultry, dollars	$ 18.70	$ 13.06	$ 11.37	$ 16.18	$ 16.38	$ 15.72	$ 15.24
Beef, pounds	79	101	155	140	134	109	120
Pork, pounds	272	228	320	293	269	275	276
Mutton, pounds	—	12	10	10	9	9	10
Honey, pounds	17	6	—	—	—	—	12
Potatoes, bushels	37	32	30	34	31	32	33
Other vegetables, dollars	$ 19.61	$ 16.51	$ 15.13	$ 16.37	$ 18.49	$ 19.28	$ 17.56
Fruit, dollars	$ 22.12	$†30.80	$ 11.02	$ 15.02	$ 13.24	$ 12.39	$ 17.43
Products canned, dollars	—	—	$ 16.87	$ 21.86	$ 25.49	$ 25.08	$ 22.32
Miscellaneous, dollars	$ 11.31	$ 1.83	$ 3.61	$ 4.98	$ 2.29	$ 1.95	$ 4.33
Total value of products used	$372.47	$264.02	$233.53	$287.28	$306.13	$293.08	$292.75
House rent (10% of value)	$203.51	$216.88	$204.78	$179.60	$187.93	$193.80	$197.75

*Farm prices were used for each particular year.
**Each year given equal weight.
†Includes both fresh and canned fruit.

of farms included in this study. However, even this small number provides some interesting information.

The average value of home-grown farm produce used by the household on these farms was $306.63 and ranged from $152 to $659 (see Table 4). This is virtually the same average figure as the one for the northern part of the Lower Peninsula. The average size of family was 3.6 adults, and 1.5 children under 16 years of age. The house rental charge averaged $144.72 and ranged from $39.20 to $351. The combined value of the farm produce and house rental charge amounted to $451.35. Table 4 also shows the average amounts and values of farm produce per family using the various items.

Variations Between Years

Economic conditions during the last few years have brought about increased interest on the part of many people in the amount of home-grown produce used by farm families. Table 5 makes it possible to compare data showing the amounts of the various products used for some recent years. Prices change from year to year and the values are, therefore, not very significant when comparing different years, but they are the best available for this study.

SOYBEAN OIL MEAL FOR PIGS

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Soybean oil meal has a high feeding value as a protein supplement to grain for all kinds of farm animals. Its relatively low cost in recent years, as compared with other feeds comparable to it in protein content, has resulted in a large increase in its use in this state. Rapid changes in methods of manufacture or extraction of the oil from the beans from which the oil meal is a by-product, have made available for purchase several different soybean oil meals. Three different types were tested by pig feeding trials at the Michigan Agricultural Experiment Station in 1940, both on pasture and in the dry-lot.

Four lots of 10 pigs each were self-fed corn and minerals on excellent alfalfa pasture. In another compartment of the feeder in each lot was placed: tankage in Lot 1, expeller soybean oil meal in Lot 2, raw solvent oil meal in Lot 3 and heat-treated or roasted solvent oil meal in Lot 4. All lots made rapid and economical gains, requiring an average of about 320 pounds of grain and supplement for each 100 pounds of gain. However, Lot 3 consumed slightly more than one-half as much raw solvent soybean oil meal as did either Lot 2 of the expeller meal or Lot 4 of the roasted solvent meal.

In another test 22 pigs were self-fed free-choice shelled corn, minerals and four different soybean oil meals: expeller, raw solvent, roasted solvent and soybean flake. The flake was similar to the raw oil meals, except that part of the fiber was removed, leaving a product higher in protein (48 per cent). The position of the four oil meals was shifted each week so that if the pigs had any preference they must find it in a new place each succeeding week for eight weeks, while their weight increased from an average of 37 pounds

to 97 pounds. They gained 1.1 pounds daily per pig and consumed the following amounts of feed for each 100 pounds of gain:

Corn	190.5 pounds
Minerals	1.5 pounds
Expeller soybean oil meal	39.7 pounds
Raw solvent soybean oil meal	.7 pound
Roasted solvent soybean oil meal	22.7 pounds
Soybean flake	1.5 pounds

This demonstrates conclusively the pigs' preference for the two heat-treated oil meals, expeller and roasted solvent.

Four lots of five pigs each were hand-fed individually in the dry-lot on the same three oil meals used in the first pasture experiment. The basal ration in each lot was the same, consisting of ground corn 80 pounds, ground barley 10 pounds, ground alfalfa 10 pounds, and minerals (equal parts of bonemeal, limestone and salt), 1 pound. Tankage and oil meal were used in the different lots so as to give the same nutritive ratio or proportion of protein. The results are shown in Table 1.

The tests demonstrate that heat-treated soybean oil meal, whether heated in the process of manufacture, like the expeller meal, or subsequently like the roasted solvent meal, is much more palatable to pigs than the raw meal. Experiments at other stations show that cooked or roasted soybeans are superior to the raw beans for pigs.

Both heat-treated soybean oil meals were more efficient and economical to feed pigs than the dry-rendered tankage used in these trials, either on pasture

Table 1. Tankage and Different Soybean Oil Meals.

Feeds used	Tankage 16 lb.	Soybean Oil Meals		
		Expeller 25 lb.	Raw Solvent 22 lb.	Roasted Solvent 22 lb.
Ground corn —80 lb. Ground barley—10 lb. Ground alfalfa—10 lb. Minerals — 1 lb.	Mixed with above-mentioned supplements.			
Average initial weight (lb.)	49	46	49	48
Average final weight (lb.)	201	199	189	197
Average daily gain (lb.)	1.19	1.29	.92	1.27
Feed per 100 lb. gain (lb.)	368	354	426	343
Feed cost* per 100 lb. gain.	$5.15	$4.60	$5.44	$4.38

*Prices used: Ground corn and barley: $1.30; alfalfa: 50 cents; minerals: $2.00; tankage: $2.50; and all soybean oil meals: $1.50 per cwt.

or in the dry-lot. The raw solvent meal gave good results on pasture, but gave much slower and more expensive gains in the dry-lot than either tankage or heat-treated soybean oil meal. If the raw solvent meal had been purchased at half the cost of the other oil meals, it would not have proved so economical in the dry-lot trial. Manufacturers are using heat treatment to overcome the disadvantage of the newer solvent extraction processes which have been widely adopted because they extract more of the oil from soybeans. Judging from these trials, one should avoid the raw white soybean oil meals when purchasing for pig feeding.

HORSE COSTS IN MICHIGAN 1937-39

F. M. ATCHLEY*
SECTION OF FARM MANAGEMENT

The year 1939 was the third and last one for the horse cost study conducted by this section of the Michigan Agricultural Experiment Station. During the year 15 farmers kept horse cost records in cooperation with this section. In 1938 there were also 15 cooperators, and in 1937 21 kept horse records.

The annual costs of maintaining horses on some Michigan farms for the three years, 1937, 1938, and 1939, and the averages of those three years are shown in Table 1. It will be noticed that the annual net cost per horse decreased each succeeding year of the study with an average of $96 per horse per year. When the latter figure is multiplied by the average number of horses kept on each of the farms where records were kept, it amounts to $307 for each farm in this project.

Table 1. Annual costs of maintaining horses on some Michigan farms, 1937-39.

Item	1937	1938	1939	Average 1937-39
Number of records	21	15	15	51
Number of horses per farm	3.4	2.9	3.2	3.2
Average age of horses	11.4	13.3	12.9	12.3
Value per horse beginning of year	$138	$ 97	$ 93	$113
Hours worked per horse in year	774	789	732	766
Annual costs per horse:				
Feed	$ 62	$ 44	$ 44	$ 52
Bedding	5	5	4	5
Man labor	26	24	17	23
Depreciation	16	14	10	14
Interest	7	5	5	6
Barn use	9	6	6	7
Harness expense	3	2	2	2
Miscellaneous	2	2	1	2
Total cost	$130	$102	$ 89	$111
Manure credit	15	16	14	15
Annual net cost per horse	$115	$ 86	$ 75	$ 96
Net cost per horse hour (cents)	14.8	10.9	10.3	12.5
Net cost of horse work per farm	$391	$249	$240	$307

Figure 1 shows the relative importance of various items of cost of keeping horses on these farms for the three-year period 1937-39. Feed costs were 47 per cent of the total, man labor 21 per cent, depreciation 12 per cent, while several smaller items comprise the remainder.

*Dr. K. T. Wright of the Farm Management section inaugurated this study in 1937 and has assisted by giving many valuable suggestions. Members of the Farm Management extension service were in charge of collecting the horse records.

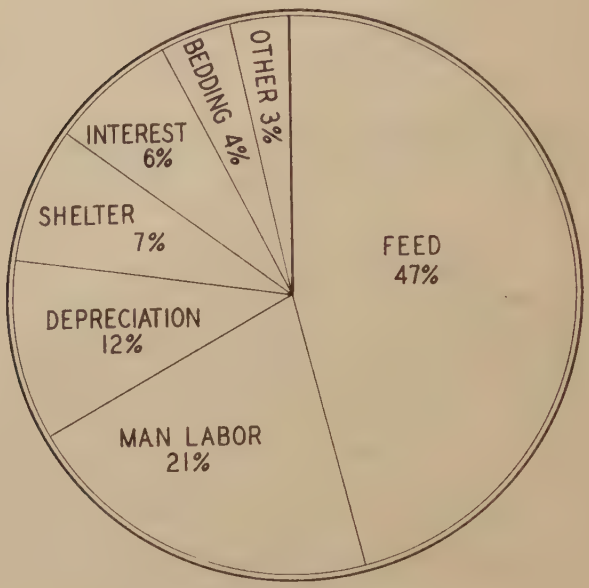

Fig. 1. Distribution of horse costs on some Michigan farms, 1937-39.

The average age of the horses on which records were kept in this study was 12.3 years (Table 2). About 55 per cent of the horses were more than 12 years old.

The total amount of corn and oats fed varied only slightly from year to year although there was some substituting of one for the other. There was a marked indirect relationship between the amount of roughage fed and the price of roughage. The average feed prices and the amounts of feed used in computing the cost of feed fed to the horses on the farms in this study are shown in Table 3. The feed prices used were those a farmer would have received or would have had to pay for feed at the farm. The price of feed in 1937 was considerably higher than in either 1938 or 1939, which is the reason for the high annual feed cost in 1937.

The relation of hours of horse work in the year to horse costs per year

Table 2. Average age of horses and percentage distribution in various age groups on some Michigan farms, 1937-39.

Item	1937	1938	1939	Average 1937-39
Number of farms	21	15	15	—
Number of horses, total	72	43	48	—
Average age of horses, years	11.4	13.3	12.9	12.3
Age groups:	Per cent in each age group			
Less than 7	21	19	21	20
7-12	26	27	22	25
13-18	34	23	43	33
19 and more	19	31	14	22

Table 3. Amounts of feed fed to horses and average feed prices on some Michigan farms, 1937-39.

Item	Unit	1937	1938	1939	Average 1937-39
Amount of feed fed per horse per year:					
Corn	bu	10	15	12	12
Oats	bu	37	28	33	34
Other grain	lb	20	95	92	65
Roughage	ton	4.3	3.4	3.7	3.9
Annual feed cost per horse		$62	$44	$44	$52
Average feed prices:					
All grain	cwt	$ 1.26	$ 0.96	$ 0.78	$ 1.04
Roughage	ton	7.90	6.49	6.79	7.28
Pasture per horse	year	4.97	2.97	3.22	3.97

and per hour on the farms in this study is shown in Table 4. There are several interesting things to be noted in this table, one of which is the big variation in the number of hours horses were used on various farms. This ranged from an average of 495 hours for the one-third using horses the least to 1,122 for the group where horses were used the most. Annual costs tended to be higher where the horses were used the most, but the net cost per hour was much less; that is 8.3 cents an hour in comparison with 18.5 cents an hour for the least used group.

Figure 2 shows graphically the influence of hours of work per horse per year on hourly costs. It may be readily seen that the more hours horses are worked, the lower the net cost per hour. This chart also shows a little upward swing on the left end of the curve, indicating that the rate of increase in cost becomes greater when the number of hours the horses are worked is less than 600 or 700 hours per year.

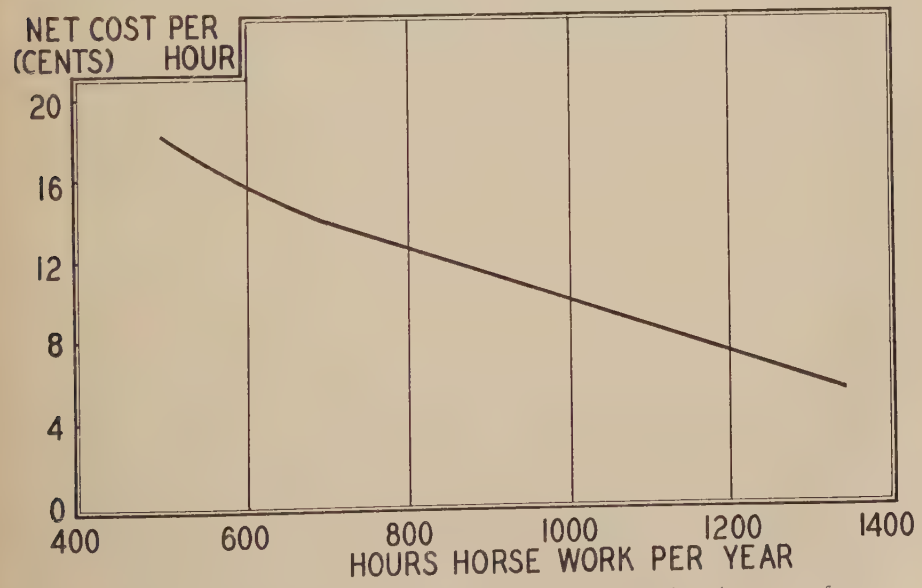

Fig. 2. Influence of hours horse work per year on hourly costs of keeping horses in Michigan, 1939.

Table 4. The relation of hours of horse work to horse costs on some Michigan farms, 1937-39.

Item	Hours horse work per year		
	Less than 600	600-799	800 and more
Number of farms	15	18	18
Total acres per farm	172	155	165
Crop acres per farm	108	97	104
Number of horses per farm	3.0	3.7	2.7
Average hours of horse work	495	687	1122
Annual costs per horse:			
Feed	$ 48	$ 49	$ 60
Man labor	21	25	22
Depreciation	17	16	8
Other	19	25	22
Total	$105	$115	$112
Net cost	92	100	93
Net cost per hour of horse work (cents)	18.5	14.5	8.3

Figure 3 shows the monthly distribution of the horse work on the farms in this study. May was the month when the horses were used the most. The hours of use in succeeding months decreased at a steady rate from then to the following January when they started increasing again.

Some significant comparisons of horse costs on farms where tractors were used and on farms where they were not used are shown in Table 5. As might be expected, the farms on which tractors were used were nearly 30 per cent larger than those without tractors. The tractor farms had larger businesses as shown by more productive man work units (P.M.W.U.) than those with-

Table 5. Comparison of labor and power costs per farm and per productive man work unit (P.M.W.U.) on farms having tractors to farms not having tractors in Michigan, 1937-39.*

Item	Farms with tractors	Farms without tractors
Number of farms	24	24
Number of men	1.9	1.6
Acres per farm	181	140
Crop acres per farm	116	81
P.M.W.U. per farm	480	357
P.M.W.U. per man	256	218
Horses per farm	2.7	3.6
Horses age	14.3	11.4
Hours worked per horse	705	789
Labor and power costs per farm:		
Man labor (own, family, hired)	$ 981	$ 874
Horse work**	269	296
Tractor use**	186	—
Total	$1,436	$1,170
Cost per crop acre	$12.38	$14.44
Cost per P.M.W.U	2.99	3.28

*Only horse records were used in this table for which corresponding farm accounts were available.
**Man labor has not been included in this item, but in "man labor" above.

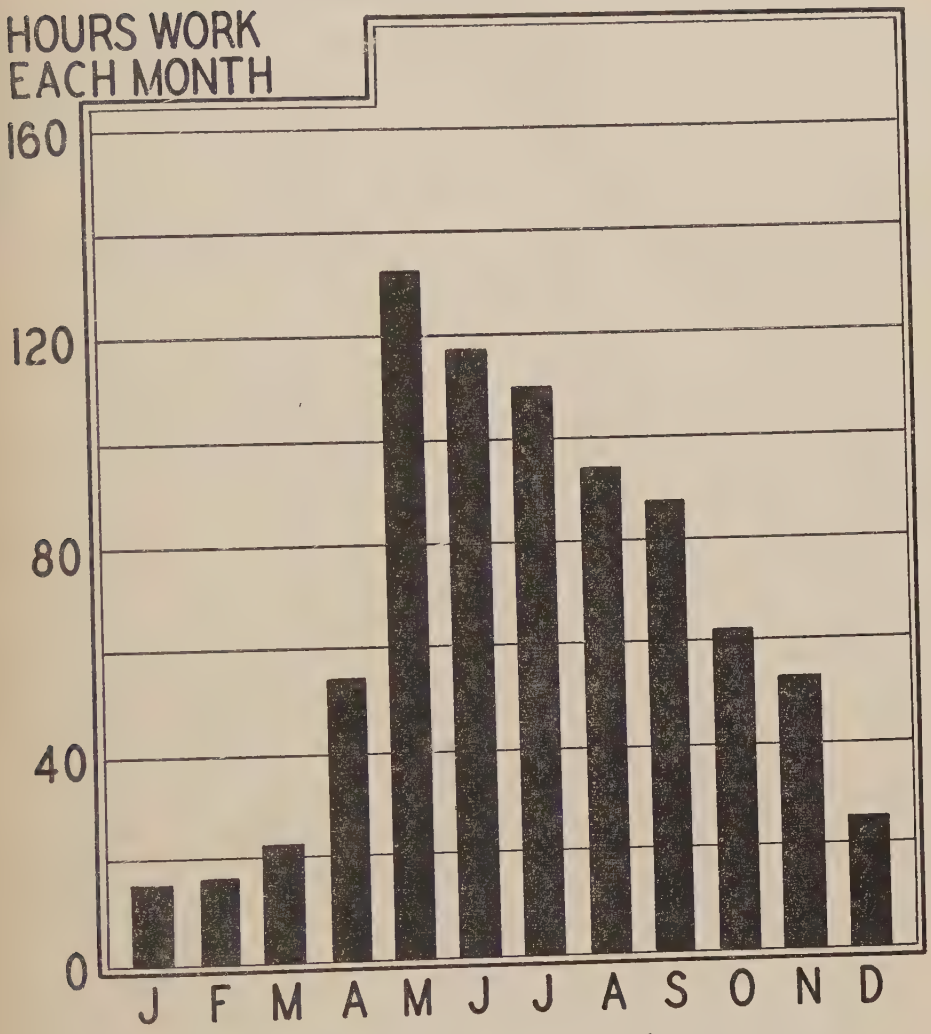

Fig. 3. Monthly distribution of horse work on some Michigan farms, 1937-39.

out tractors. These tractor farms also had more P.M.W.U. per man than the other group, indicating about 17 per cent greater efficiency in the use of man labor. The tractor farms had fewer horses and the horses were slightly older than those on the non-tractor farms. The horses were not worked as much on the larger tractor farms as they were on the non-tractor farms. Total labor and power cost per farm was considerably higher on the tractor farms than on the non-tractor farms, due primarily to their larger size. The labor and power costs per crop acre and per P.M.W.U., however, were appreciably lower on the tractor farms, indicating about 10 per cent more efficient use of labor and power on these larger, more mechanized farms.

In conclusion, one may say that a major lesson to be gained from this

study is that idle horses are expensive horses and one had better keep only those he needs. A farmer maintaining a tractor as well as horses should study his total power needs in some detail and be certain that he does not have more power available than he can use efficiently.

OVEREATING (*Enterotoxemia*) IN FEEDLOT LAMBS*

FRANK THORP, JR.
SECTION OF ANIMAL PATHOLOGY

The most serious disease affecting lambs on feed is overeating. Data collected by the Colorado Agricultural Experiment Station (1939-40) show that this disease was encountered in about half the lambs submitted for autopsy. Reports from other lamb feeding areas indicate that considerable losses are experienced due to this condition.

The primary cause of the condition seems to be the eating of too much concentrated feed such as corn, cane, barley and peas.

The "lambing down" of corn, cane, and peas is for the most part an unsuccessful method of fattening lambs. The lambs appear to thrive well for a period of two weeks to a month at which time the disease begins to manifest itself. At about this time it is usually found that the leaves from the grain plants and grass from the fence rows have been consumed, leaving mostly grain as the diet. If a high wind should blow down the stalks making more grain available, large losses in lambs are usually encountered the next morning.

Losses from overeating may occur early in the feeding period. This may be true if the lambs are given too much grain at the beginning. Early losses have been observed during outbreaks of coccidiosis and sore mouth. In either disease all the animals are not affected to the same degree and, therefore, the affected ones eat but little while the others consume more than their share.

Overeating is truly an enterotoxemia since a thermolabile (rendered harmless by heating) toxin has been found in the small intestines of a large proportion of lambs dying of this condition.

Investigators at the Colorado Agricultural Experiment Station have shown that the contents of the small intestines from lambs dead of overeating are usually toxic for rabbits, guinea pigs, mice, rats and lambs when given subcutaneously or intravenously. The toxic intestinal contents are always neutralized by *Clostridium perfringens* antitoxin type D and usually by type B but never by types A and C. Experimentally the disease has not been produced by the oral feeding of the toxic material. However, the disease is probably due to the absorption of the toxin from the small intestines.

It is not unusual for lambs to be found dead in the morning despite the fact that the animals were apparently healthy the night before. Scouring among some of the larger lambs manifested by the matting of wool with fecal material around and below the anus should be a warning sign. The affected animals are invariably the largest, fattest, most vigorous and greediest lambs in the lots. A few of the animals may throw back their heads, stagger for a

*This paper is based on the result of researches by the author while connected with the Colorado Agricultural Experiment Station and is published with the permission of the Director of that Station.

little while, then fall and die in convulsions. Others often live for a few hours, either standing with heads drawn back or heads lowered, moving in a circle, pushing against the fence, or falling to the ground and lying there swinging their legs back and forth. Recovery is rare in this disease.

Gross lesions may not be observed in some of the acute cases. Whole grain is usually found somewhere along the digestive tract. Inflammation of the abomasum and small intestines is a common finding. The Peyer's patches are usually congested. Blotchy hemorrhages may be found under the peritoneum of the abdominal muscles, on the diaphragm, under the serosa of the intestines and abomasum. The pericardial sac usually contains straw-colored fluid which often shows some coagulum. Petechial hemorrhages are invariably present on the thymus. Petechial and ecchymotic hemorrhages may be present under the epi- and endocardium. In acute cases, at first sugar is usually present in the urine. If the animals live for a day or more, sugar usually is not found in the urine.

A history of fat lambs dying on full feed is indicative of overeating provided autopsy fails to reveal pneumonia and bacteriological findings are negative. The finding of sugar in the urine of acute cases is regarded as diagnostic. Among uninformed persons, overeating is sometimes mistaken for so-called "hemorrhagic septicemia". Likewise the presence of the fringed tapeworm *(Thysanosoma actinioides)* in the bile ducts and intestines is often erroneously given as the cause of the disease. Data obtained by the Colorado Agricultural Experiment Station do not substantiate this claim.

If sudden deaths occur when lambs are on full feed or if some go off feed this should indicate a reduction in the amount of grain fed. Death losses can be stopped overnight by withholding grain. The most satisfactory method of control is to decrease the grain to a point where no further trouble occurs and then increase it gradually. The animals should be lotted according to size and packed at the feed trough so that when a lamb leaves its place no other room is available. The grain should be evenly distributed in the troughs in order that each lamb may receive only its share. Such feeds as ensilage and beet pulp should be figured to take the place of some of the grain ration. Ensilage often contains from a fourth to a third of its weight in grain.

Improper management figures greatly in the complex disease overeating.

BULLETIN REVIEWS

Circ. Bul. 175—Sugar Beets in Michigan—Rather, H. C. *et al.*—This publication presents information on the sugar beet industry of Michigan, on culture of the crop, diseases and their control, production costs and various methods of utilizing crop residues. The material was contributed by seven departments of the Station. (53 pp., 6 tables, 29 figs.)

Spec. Bul. 304—Some Important Michigan Weeds—Darlington, H. T., Bessey, E. A. and Megee, C. R.—This bulletin presents a key to the identification and description of 94 of the more important weeds found in Michigan. Information is given on habitat and distribution and suggestions for control. (216 pp., 94 figs.)

Spec. Bul. 305—Sugar Beet Costs and Returns—Wright, K. T.—Sugar beet production costs on the farms in this study, producing about 10 tons of beets per acre, averaged about $39 an acre for the period 1933-36. Marketing costs amounted to approximately $9 an acre, making a total cost of $48. Income totaled about $70 an acre, leaving a net return of approximately $22 an acre.

Approximately 85 hours of man labor was spent per acre, with about 70 hours being hand work, and 15 hours for the other operations. There was also an average of 26 hours of horse labor and 2½ hours tractor use per acre, or a horse equivalent of approximately 40 hours.

The charge for hand labor made up one-third of the total cost of producing and marketing beets. The charge for the grower's own labor, use of power and machinery, made up about 18 per cent of the total, land use 16 per cent, other production costs 15 per cent, and marketing costs 18 per cent.

Total production cost per ton on the farms covered by this study varied from approximately $3 to $10, but a range of 80 cents a ton on each side of the average production cost of about $4 a ton included one-half the growers, while a range of $1.20 a ton on each side of the average included two-thirds of the growers. That is, the production cost of one-half the growers was between $3.20 and $4.80 a ton, and two-thirds between $2.80 and $5.20 a ton. The delivered cost was about $1 a ton higher.

Growers having yields of around 6½ tons per acre had a production cost of $5.74 a ton, compared with $3.21 for those averaging approximately 13 tons per acre. Net return per acre was more than 10 times as high for the high-yield as for the low-yield men.

Such factors as soil type, drainage, amount of manure and fertilizer applied, time of plowing and planting, and row width, all affected yield per acre and cost per ton. Other factors, such as acres of beets per farm, the grower's efficiency with labor, power and machinery, and the hand labor method, had considerable effect on the cost per acre and consequently per ton of beets. Distance to the plant affected the marketing cost, and consequently the net return, the same as did differences in production cost per acre or yield of beets. (45 pp., 33 tables, 12 figs.)

JOURNAL ARTICLE ABSTRACTS

Some Soil Factors Affecting Boron Availability—Cook, R. L. and Millar, C. E.—Soil Sci. Soc. Amer. Proc. *4:* 297-301. 1939. [Journal Article No. 414 (n. s.) from the Michigan Agricultural Experiment Station.]—The research outlined in this paper was an attempt to correlate the occurrence of heart rot of sugar beets with soil conditions. Partial analyses of 130 field soil samples were compared with the incidence of heart rot on the soils sampled. These data show that heart rot occurred more often on alkaline than on acid soils, and a positive correlation was found, within each group separately, between heart rot occurrence and the active calcium content of the soils. (Active calcium content was determined by leaching 10-gram samples of the soils with acidified ammonium acetate). No correlation was found between heart rot occurrence and the available B_2O_3 content of the surface soil. Field observations indicated, however, that excessive leaching was conducive to heart rot occurrence. By the use of pot cultures it was discovered that soybeans were easily injured by an excess of borax in the soil and that the toxicity symptoms, which occurred as yellowish-brown spots around the edges of the leaflets, can be recognized easily. Soybeans, accordingly, were used to measure the availability of boron applied to the soil in borax. It was found, thereby, that calcium and magnesium carbonates very effectively fixed boron in some chemical form unavailable to soybeans, while sodium carbonate had no effect on its availability. Calcium and magnesium sulphates caused boron to be partially fixed in a form not available to soybeans in the Hillsdale soil, but they had no effect in the Warsaw soil. Sodium sulphate had no effect in either soil. These results indicate that the boron of borax is fixed in the soil as insoluble borates of calcium and magnesium, which form chiefly in alkaline soils.

A Comparative Study of the Insect Food of Trout—Morofsky, W. F. —Jour. Econ. Ent. *33* (3): 544-547. 1940. [Journal Article No. 417 (n. s.) from the Michigan Agricultural Experiment Station.]—A study of the insect content of the stomachs of 1,548 trout taken from northern and southern Michigan trout streams discloses that 95 per cent of the insects eaten belong to a few groups. It is apparent that in the material examined insects far outnumbered all other animals. Consideration of the insects consumed by the three species of trout in Michigan streams indicates that certain kinds are eaten in very large number by brook and brown trout, but that rainbows are more or less general feeders; also, the insects eaten are similar in northern and southern Michigan streams.

Cerebrospinal Fluid Pressure and Vitamin A Deficiency—Moore, L. A. and Sykes, J. F.—Am. Jour. Physiology *130* (4): 684-689. 1940. [Journal Article No. 421 (n. s.) from the Michigan Agricultural Experiment Station.]—The authors have shown that a deficiency of vitamin A in the ration of the young bovine produces an increased cerebrospinal

fluid pressure. The increase in pressure is accompanied by papilledema, nyctalopia, syncope, and incoördination. The above disturbances slowly disappeared when the animals were returned to a normal ration or when crystalline carotene was added to the deficient ration.

Borax as a Control for Heart Rot of Sugar Beets—Cook, R. L.—Better Crops with Plant Food. *24* (5) : 12. 1940. [Journal Article No. 422 (n. s.) from the Michigan Agricultural Experiment Station.]—Sugar beets, grown in Thomas sandy loam pot cultures, were supplied with a complete nutrient solution as a control treatment. Copper, manganese, magnesium and boron were separately omitted from and doubled in quantity in the control treatment solution to ascertain the effect of each of these elements on the development of the plants. Borax, applied at the rate of 10 pounds per acre, prevented heart rot, practically doubled yields and significantly increased the sucrose content of sugar beets. Copper, manganese and magnesium neither prevent heart rot nor affect the yield and sucrose content of sugar beets.

During 1937, 1938 and 1939 experiments were conducted in 10 fields located on six soil types. Borax, included in 2-12-6 fertilizer, was applied broadcast and in the row at rates ranging from 10 to 80 pounds per acre. In one experiment borax was applied as a side-dressing. The effect of heart rot on sucrose and purity percentages was determined by collecting samples from fields not included in the experiments.

When applied broadcast at rates as high as 80 pounds per acre borax did not injure stands nor reduce yields. When applied in contact with the seed at the rate of 10 pounds per acre, this material caused injury on one field in 1939 but did not reduce the stand on seven other fields in 1938 and 1939; as much as 40 pounds of borax applied with the seed did not reduce the stand on some soils. Applied in a band at the side of the seed, borax was much less harmful to stand than when applied in contact with the seed.

Borax applied broadcast or with the seed did not significantly increase sugar beet yields. Significance would probably have resulted in some cases had it been possible to better control experimental errors. Borax applied as a side-dressing on an area where heart rot was very severe significantly increased total sugar beet yields and more than doubled the yield of normal beets.

Borax applied in the row at the rate of 10 pounds per acre almost completely prevented heart rot occurrence. Broadcast applications at the same rate were somewhat less effective and on one field the 20-pound application produced significantly better results than did the 10-pound application.

Sugar beets having heart rot contained less sucrose than did normal beets and on one field the sugar beets having heart rot had a lower percentage purity than did normal beets.

Relation of Boron to Heart Rot in the Sugar Beet—Cox, T. R.—Jour. Amer. Soc. Agron. *32*:354-370. 1940. [Journal Article No. 424 (n. s.) from the Michigan Agricultural Experiment Station.]—Sugar beet seedlings were grown in quartz sand cultures, with and without borax. Seedlings grown in jars without borax developed characteristic deficiency symptoms as follows: blackening of tips of heart leaves, followed by death of growing portion of crown; shortened, twisted

petioles associated with crinkled condition of leaves; pimpled condition of petioles in early stages, followed by breakdown in form of cross and linear checking; abnormally dark green and thickened leaves, accompanied by more rapid wilting; yellowing and eventual death of outer leaves; stunted second growth leaves following death of first leaves; breakdown of beet root heart; darkened areas under the surface of the root and development of surface cankers; restricted fibrous root system. Symptoms appeared about two months after seedlings were transplanted and yields were increased as much as 80 per cent by borax applications. Seedlings showing advanced stages of heart rot definitely recovered upon the application of 4.9 mg. of borax per 5000 gm. sand. Halves of field-grown mother beets planted in quartz sand cultures without borax produced stunted leaves with marked symptoms of boron starvation, whereas the corresponding halves which received like treatment but with borax added at the rate of 2 mg. per 5000 gm. sand, produced a more abundant leaf growth free of deficiency symptoms. Soil tests for available boron showed that a crop of sugar beets produced in pot cultures removes an appreciable quantity of boron from the soil. By determining the quantity of B_2O_3 in leachates from pot cultures it was found that it was relatively easy to remove added borax from soils by leaching with distilled water even a year after the borax was applied.

Rumen Digestion in the Bovine, with Some Observations on the Digestibility of Alfalfa Hay—Hale, E. B., Duncan, C. W., and Huffman, C. F.—Jour. Dairy Sci. *23* (10): 953-967. 1940. [Journal Article No. 430 (n. s.) from the Michigan Agricultural Experiment Station.]—Methods of studying rumen digestion in the bovine were investigated and the use of lignin ratios is proposed as a method of quantitatively determining digestion in the rumen. Iron ratios were not reliable for this purpose. The lignin index is relatively accurate and it was found by its use that 90 per cent of the digestible dry matter, all of the digestible N. F. E., other carbohydrates and new N. F. E., 85 per cent of the digestible cellulose, almost two-thirds of the digestible crude fiber, and 59 per cent of the digestible protein of alfalfa hay were removed from the ingesta by rumen digestion. Lignin was not appreciably digested in the rumen but was digested to some extent in the remainder of the digestive tract. Ether-extractive substances accumulated after the ingesta passed from the rumen. True fat was not digested to any extent in the rumen and at the 30-lb. level of feeding there was an increase in true fat. This suggests the synthesis of fat by rumen microorganisms.

Rumen pH averaged 6.82 and the maximum acidity was reached six hours after feeding. Rumen temperature approximated 39° C. The character and amount of rumen fill were not affected by the amount of hay consumed. The rumen was capable of digesting highly variable quantities of roughage with equal efficiency. All nutrients were less digestible (total digestion) at a sub-maintenance level of nutrition, but otherwise the plane of nutrition did not have any marked effect on the digestibility of the hay.

The separation of the carbohydrate fraction into lignin, cellulose and other carbohydrates is a better index to the biological value of alfalfa hay than the present division into crude fiber and N. F. E. An

enzymatic determination of crude fiber gave a much sharper distinction between the two carbohydrate fractions than the common method. A true fat determination was of greater biological significance than the ether extract determination.

Isolation of Carotene from Green Plant Tissue—Petering, H. G., Morgal, P. W. and Miller, E. J.—Ind. and Eng. Chem. *32:* 1407-1412. 1940. [Journal Article No. 431 (n. s.) from the Michigan Agricultural Experiment Station.]—A new method, much less difficult than methods heretofore available, for extracting carotene from plant tissue is briefly described as follows: Dehydrated alfalfa leaf meal is extracted with acetone. The extract is refluxed with solid barium hydroxide octahydrate. This causes chlorophyll and saponifiable lipoids to be removed as a green sludge. The solution is concentrated until a waxy residue containing the carotene separates, leaving flavones and other water-soluble constituents in solution. The waxy residue is extracted with cold acetone; most of the carotene and xanthophyll and some of the lipoidal matter go into solution. The extract is concentrated to an oil, taken up into petroleum solvent, and purified of contaminating xanthophyll and lipoidal matter by available method. The simplicity of the method is due to the procedure devised for removing chlorophyll and saponifiable lipoids. The efficiency of the barium hydroxide octahydrate treatment is dependent on the particle size of the solid and on the ratio of acetone to water in the solution of plant pigments. Proteins, carbohydrates, cellulose, and other plant materials not extractable are not destroyed in this procedure.

Twelve New North American Species of *Oscinella* (Diptera, Chloropidae)—Sabrosky, C. W.—Canadian Entomologist. *72* (11): 214-230, 1 plate. 1940. [Journal Article No. 444 (n. s.) from the Michigan Agricultural Experiment Station.]—The genus *Oscinella* includes a number of species of small flies whose larvae attack various grains and grasses. One such species sometimes causes losses of 10 per cent or more to the wheat crop in some parts of Europe. The present contribution to the classification of the American species recognizes 12 kinds new to science.

Two Hundred Tell What They Prefer in Pickle Sweetness—Switzer, R. G. and Fabian, F. W.—Food Industries. *12* (11): 38-40. 1940. [Journal Article No. 445 (n. s.) from the Michigan Agricultural Experiment Station.]—To determine the relative merits of two commonly used sweetening agents for pickles, four series of jars were prepared. In the first two the sugar was kept virtually constant at 37° Brix to 20.3° Baume and the acidity kept at two levels, 2.0 and 2.28 per cent acid, calculated as acetic. In the second experiments the sugar was kept constant at approximately 18.2° Baume and the acidity varied as in the first series. Three combinations of sugar were used in all experiments as follows: 100 per cent sucrose, a combination of 75 per cent sucrose and 25 per cent dextrose, and a combination of 50 per cent sucrose and 50 per cent dextrose. Several hundred jars in each series were available for testing.

Jars of all the various combinations were then sent to 40 different pickle companies and food laboratories to obtain a representative cross section of opinion from all parts of the country. Approximately 200 people compared the flavor and general palatability of the different

series of pickles. The samples were marked in code so as to preclude the possibility of identification of the various combinations. The tasters were asked to record their preference in each series as first, second and third choice. The results of the tasters' preference for the various combinations may be summarized as follows:

The ideal combination of sucrose and dextrose in a 20° Baume, sirup at 20 grains acidity is 75 per cent sucrose and 25 per cent dextrose.

Increasing the acidity 2.8 grains in a 20° Baume sirup decreased the number of first choices in the sucrose-dextrose combination as compared with sucrose alone.

Reducing the sugar concentration from 20° to 18° Baume at 20 grains acidity decreased the number of first choices, but not so much as increasing the acidity 2.8 grains at 18° Baume.

Increasing the acidity 2.8 grains in both the 18° and 20° Baume sirups reduced the number of first choices in both the sucrose-dextrose combinations as compared to sucrose alone.

The tasters were more sensitive to slight increases in acidity than they were to slight reductions in sweetness.

There is a very definite ratio between the grains acid and the degrees Baume in pickles. Within practical limits, for every grain increase or decrease of acetic acid there should be a corresponding increase or decrease of one degree Baume.

Control of Cedar Rust with Sodium Dinitrocresylate—Strong, F. C. and Cation, D.—Phytopathology *30* (11) : 983. 1940. [Journal Article No. 447 (n. s.) from the Michigan Agricultural Experiment Station.]—A 1-per cent solution of Elgetol (sodium dinitrocresylate) was sprayed on red cedar trees bearing galls of the cedar-apple and cedar-hawthorn rust fungi. One application was made when the galls were showing activity in May 1940. Telial column (horn) extension and spore germination were completely inhibited. No injury to the foliage of red cedar was observed. Slight injury to foliage of some quince rust infected dwarf juniper branches occurred.

The success of these preliminary tests gives promise of the development of a simplified spray control of these two rusts so troublesome on ornamental plantings. One spray application on the coniferous host at the proper time appears to prevent the infection of the pomaceous host, eliminating the necessity of spraying the latter.

Identification of *Salmonella pullorum* Colonies with Immune Serum by means of a Microscopic Plate Test—Stafseth, H. J. and Corbett, A. C.—Am. Jour. Vet. Res. 1 (1) : 76-77. 1940. [Journal Article No. 456 (n. s.) from the Michigan Agricultural Experiment Station.]—The method of isolating and identifying the *pullorum* disease organism usually employed is as follows: Cultures from tissues thought to harbor the germ are made on plain agar or brilliant green agar plates, which are incubated at 37° C. overnight. If colonies resembling those characteristic of *S. pullorum* are found, transfers are made to agar slants which are incubated overnight. When sufficient growth has been obtained, several different fermentation media are inoculated and incubated as before, overnight or until typical fermentation reactions are obtained. Usually a minimum of 72 hours is required.

A method of diagnosis is explained which requires that a sufficient

amount of growth be obtained for a turbid suspension of the organisms in a large drop of a very potent agglutinating serum. When this mixture is made, clumping (agglutination) will take place instantly if the organism is *S. pullorum* or *Salmonella gallinarium,* the cause of fowl typhoid. These two organisms are so closely related that the diseases caused by them may well be considered as one problem. The time required for this procedure is 15 to 48 hours.

Vibrionic Abortion in Michigan Sheep—Ryff, J. F.—Jour. Am. Vet. Med. Assoc. *97* (764) : 452-453. 1940. [Journal Article No. 466 (n. s.) from the Michigan Agricultural Experiment Station.]—Vibrionic abortion in sheep, previously reported in New York, Illinois and Montana, was identified in three flocks of Michigan sheep for the first time. In one flock of 79 sheep, 37 lambs from 25 ewes were lost through this cause, although no fatalities were encountered in the ewes. *Vibrio fetus* was recovered from four lambs examined. Thirty-seven of the 79 sheep had a positive agglutination reaction in 1:25 dilution; 10 were positive in 1:100 dilution. Six of the latter samples were from sheep that had aborted. Nine normal sheep from an uninfected flock did not react in 1:25 dilution. Because no new sheep had been introduced and the cattle on this farm showed no significant reaction to the agglutination test, a neighboring flock of sheep troubled by abortion may have served as the source of infection.

Simple Turkey Curing and Smoking Method Developed—Schaible, P. J., Davidson, J. A. and Sykes, J. F.—The National Provisioner. *103* (11) : 17-18. 1940. [Journal Article No. 469 (n. s.) from the Michigan Agricultural Experiment Station.]—Using the facilities of a commercial packing plant, a practical method of curing and smoking turkey was developed.

Equipment and materials in common use for pork curing and smoking were found adaptable to processing turkeys but the procedure was very different. Smoked turkey was preserved indefinitely by hard freezing.

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